Rice and Sturgeon Lakes Nutrient Budget Study

Nutrient Budget Data For The Watersheds of Rice Lake and Sturgeon Lake 1986-1989

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NUTRIENT BUDGET DATA FOR THE WATERSHEDS OF RICE LAKE AND STURGEON LAKE

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PREFACE

The Kawartha lakes are a large and economically important system of eight lakes which are located in central Ontario. Sturgeon Lake and Rice Lake are located near the upper and lower ends of the Kawartha Lakes system respectively and both support significant amounts of urban and recreational development. They were chosen for detailed study because of their importance within the system and because both have shown the symptoms associated with excessive nutrient input for several years.

The Rice and Sturgeon Lakes Nutrient Budget Study was initiated to investigate linkages between point and non-point sources of nutrients, water quality, and aquatic life within the lakes and to estimate the impacts of these processes on in-lake and downstream water quality.

The study was supervised by the Rice - Sturgeon Lakes Nutrient Budget Technical Committee which had representatives from the Limnology Section (Water Resources Branch) and Central Region of the Ministry of the Environment, the Trent Severn Waterway (Environment Canada) and the Kawartha Lakes Fisheries Assessment Unit of the Ministry of Natural Resources.

This is one of a series of technical reports. These and the summary report (R/S Tech. Rep. No. 13) will provide a technical basis for the management of the Rice Lake and Sturgeon Lake ecosystems and for the use of land and water resources in the Kawartha Lakes region in general. A list of all reports in the R/S Tech. Rep. series is as follows:

1. Hutchinson N.J., B.J. Clark,, J.R. Munro and B.P. Neary 1994. Hydrological data for the watersheds of Rice Lake and Sturgeon Lake.1986 - 1989, 100 pp.

2. Hutchinson N.J., J.R. Munro, B.J. Clark and B.P. Neary, 1994. Water chemistry data for Rice Lake, Sturgeon Lake and their respective catchments 1986-1989, 169 pp.

3. Hutchinson N.J., B.J. Clark J.R. Munro and B.P. Neary, 1994. Nutrient Budget data for the watersheds of Rice Lake and Sturgeon Lake. 120 pp.

4. Ryback, M. and I. Rybak. 1994. Sediment pigment stratigraphy as evidence of long term changes in primary productivity of Sturgeon and Rice Lakes (Kawartha Lakes). 24 pp.

5. Nicholls, K.H., M.F.P. Michalski and W. Gibson. 1994. Trophic interactions in Rice Lake I: An experimental demonstration of effects on water quality.

6. Limnos Ltd. 1994. Partitioning of phosphorus in *Potamogeton crispus*. 22 pp.

7. Limnos Ltd. 1994. Rice Lake Macrophytes: distribution, composition, biomass, tissue nutrient content and ecological significance. 123 pp.

8. Beak Consultants Ltd. 1994. Release of phosphorus from Rice Lake sediments. 31 pp.

9. Limnos Ltd., Michael Michalski Associates and D.J. McQueen. 1994. Trophic interactions in Rice Lake II. Young-of-the-year yellow perch - *Daphnia* interactions, preliminary findings. 101 pp.

10. Badgery, J.E., D.J. McQueen, K.H. Nicholls and P.R.H. Schaap. 1994. Trophic interactions in Rice Lake III: Potential for biomanipulation. 1988 and 1989 .

11. Standke, S. 1994. The zooplankton of Rice Lake and Sturgeon Lakes, 1986-1988, Kawartha Lakes, Ontario .

12. Nicholls, K.H. 1994. The phytoplankton - water quality relationships of the Kawartha Lakes, 1972-1989.

13. Hutchinson, N.J., K.H. Nicholls and S. Maude, 1994. Rice and Sturgeon Lake Nutrient Study: Summary and recommendations.

SUMMARY

Mass balance budgets of total phosphorus, chloride and potassium were detemined for Rice Lake and Sturgeon Lake on a monthly, seasonal and annual basis for the period of June 1986 to May 1989. The average annual balances for chloride were 97% and 102% for Rice and Sturgeon Lakes respectively, indicating that all budget terms were accurately measured. Total phosphorus budgets showed average annual balances of 79% and 76% for Rice and Sturgeon Lakes indicating the retention of 21 and 24 % of total phosphorus inputs within each lake. Rice Lake showed a net export of phosphorus in the autumn compared to Sturgeon Lake which showed little seasonality of phosphorous retention. The potassium budget in Rice Lake also showed distinct seasonal fluctuations which was likely a response to the extensive community of aquatic macrophytes.

The Otonabee River contributed 82% of the phosphorus supply to Rice Lake and 30% of all the Rice Lake phosphorus load was contributed by point sources. Phosphorus loadings were more evenly distributed among sources to Sturgeon Lake and point sources added 17 % to the total load.

This report contains detailed information on each budget component, relates elemental loads to hydrologic and in-lake processes and presents export figures (in kg and mg/m^2/yr) for each budget component.

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INTRODUCTION

The Rice and Sturgeon Lakes Nutrient Budget Study was initiated by the Ontario Ministry of the Environment (MOE, now the Ontario Ministry of Environment and Energy, MOEE) in 1986 with the participation of the Ontario Ministry of Natural Resources (MNR) and Parks Canada. Objectives of the study were to:

1) Construct a detailed nutrient budget for Rice and Sturgeon Lakes.
2) Link the nutrient inputs and outputs to water quality in each lake and in particular to levels of blue-green and other planktonic algae and to rooted aquatic macrophytes.
3) Estimate the impact of Sturgeon and Rice Lakes on the water quality downstream.
4) Develop a nutrient management plan for each lake and make recommendations on the necessity of controlling point and non-point source nutrient inputs.

This report presents individual and summarized mass balances (budgets) of total phosphorus (TP), chloride and potassium for Rice and Sturgeon Lakes for the period of June 1, 1986 to May 31, 1989. Each budget links the hydrologic budgets (Hutchinson et al 1994a) with concentrations of TP, chloride and potassium (Hutchinson et al 1994b) to estimate total loadings and losses of each element.

Total phosphorus budgets were estimated to help explain existing patterns in phosphorus concentration and to explore various management alternatives for each lake. Chloride budgets were estimated to compare the dynamics of a conservative ion (which is not taken up or lost by in-lake processes) with phosphorus to verify that all requisite terms were included in the TP budget. Potassium budgets were estimated to help understand the growth and senescence of the large aquatic macrophyte community in Rice Lake, as potassium is quickly cycled through aquatic macrophytes. This budget also served as a further check on the accuracy of the phosphorus budget, as potassium is not retained on an annual basis.

The components of an elemental budget can be expressed by the principle of the conservation of mass. For a lake this equation can be written as:

$\mathbf{P + R + G + PS + S - O - A = S}$ where:

P = loading from precipitation to the lake surface
R = loading from surface runoff, including upstream lakes
G = loading from groundwater
PS = loading from point sources, including shoreline development
S = loading from resuspension of lake sediments
O = loss to outflow
A = loss by fish harvest
S = change in lake storage; as retention in sediments and biota or by changes in volume.

Mass balance budget models, whether quantifying the flux of nutrients or water through a lake, require detailed data on all inputs, outputs and in-lake processes such as storage or release. Balance between input and output terms, after correction for storage terms,

gives the modeller confidence that the model is correct and can be used to explore management alternatives.

This report presents elemental balances determined for three consecutive 12 month periods between June 1, 1986 and May 31, 1989. The June to May hydrologic year was chosen to minimize the effects of snowpack storage and spring melt on the hydrologic balance, as these events are complete by June 1. Although data collection was started in February 1986, complete records for the entire network were not available until April 1986. The period of incomplete record, and the April-May 1986 records are not included in this report. Elemental balances were calculated for monthly, seasonal and hydrologic year periods of observation. Seasonal totals were calculated for summer (June, July, August), autumn (September, October, November), winter (December, January, February) and spring (March, April, May).

This report presents data on elemental balances only. Hydrologic budget and water chemistry data are presented in two separate volumes, Hutchinson et. al (1994a), and Hutchinson et. al. (1994b). Biological data are given in a series of 9 reports and all data are summarized in the final report of the Rice and Sturgeon Lake Study (Hutchinson et. al. 1994d). All report titles are given in the preface to this volume.

All raw data and summaries from this report are available in flat ASCII or Lotus 123 format on floppy disc from the Dorset Research Centre, Ontario Ministry of the Environment and Energy, PO Box 39, Dorset, Ontario, POA 1EO

DESCRIPTION OF STUDY AREA

Rice and Sturgeon Lakes are two large lakes located in the Kawartha Lakes Region of Ontario. They form part of the Rideau-Trent Severn waterway, a 680 km corridor of lakes and connecting waterways extending from Port Severn on Georgian Bay to Trenton on the Bay of Quinte and extending northeast to Ottawa. The location of Rice and Sturgeon Lakes is shown in Figure 1.

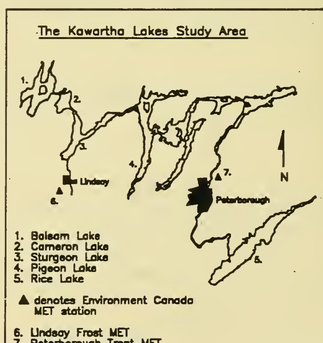


Figure 1: The Kawartha Lakes region showing the location of Rice and Sturgeon Lakes and the meteorological stations used in the study.

The surface area of Sturgeon Lake is 4,710 ha and it drains a watershed area of 476,000 ha. (Table 1). The major inflow to Sturgeon Lake is the outlet of Cameron Lake at Fenelon Falls (Figure 2). This drainage is predominately (75%, Hutchinson et al 1994a) from forested Precambrian Shield areas in the basins of

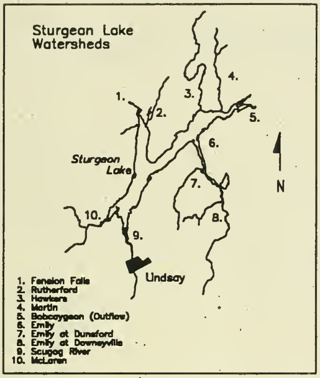


Figure 2: Location of the Sturgeon Lake hydrology monitoring network.

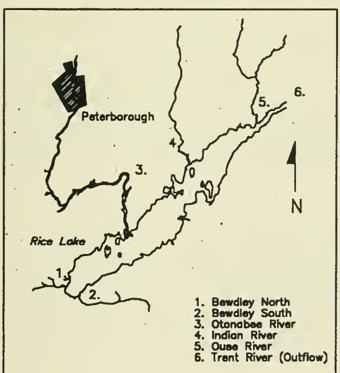


Figure 3: Location of the Rice Lake hydrology monitoring network

the Gull River and Burnt River, which discharge into Balsam and Cameron Lakes respectively. The Scugog River drains Lake Scugog and discharges into Sturgeon Lake at Lindsay. The Scugog River, and the remaining portions of the Sturgeon Lake watershed, drain mixed agricultural, wetland and forested land within the Oak Ridges Moraine, the Till Plain, the Lowland Plain and the Limestone Plateau (Kawartha Region Conservation Authority 1982). Smaller sections of the immediate watershed of Sturgeon Lake are drained by numerous small streams (Figure 2), which will be described in a subsequent section.

Water from the outlet of Sturgeon Lake at Bobcaygeon flows through Pigeon, Buckhorn, Lower Buckhorn, Lovesick, Stony and Katchewanooka Lakes; entering the Otonabee River at Lakefield. From Lakefield, the Otonabee River flows through the City of Peterborough and discharges to Rice Lake at Campbelltown.

The drainage area between Sturgeon and Rice Lakes receives runoff from the Precambrian Shield via many creeks, including Jack Creek, Eels Creek and the Mississagua River, but the majority of drainage is from mixed agricultural, forested and wetland areas overlying till plains and sedimentary rock. The hydrology of Rice Lake is driven mainly by discharge from the Otonabee River with small inputs from the Indian and Ouse Rivers on the north shore (Figure 3). A total of 58 smaller creeks flow into Rice Lake from the immediate watershed. Two of these were monitored to estimate total runoff from this source and will be described in the next section. Rice Lake has a surface area of 10,010 ha and drains 914,000 ha (Table 1). From its outlet to the Trent River at Hastings, water flows to the Bay of Quinte at Trenton and then to Lake Ontario.

Table 1: Mean depth, volume, surface and watershed area, and hydraulic residence time for Rice and Sturgeon Lakes.

Rice Lake	Lat. 44° 12' Long 78° 10'	
	Mean Depth	2.4 m
	Volume	2.4×10^8 m^3
	Surface Area	10,010 ha
	Watershed Area	914,125 ha
	Residence Time	33.9 days
Sturgeon Lake	Lat. 44° 28' Long 78° 43'	
	Mean Depth	3.5 m
	Volume	1.6×10^8 m^3
	Surface Area	4,710 ha
	Watershed Area	476,377 ha
	Residence Time	38.6 days

The watershed of Rice Lake is regulated by a series of dams. These control discharge from every lake in the Trent-Severn system and many lakes in the headwaters in Haliburton, Peterborough and Victoria Counties to the north. The Trent-Severn Waterway requires a regulated flow of water mainly for navigation purposes, but the hydrologic budget is also managed for power generation, flood control, recreation and protection of fish habitat.

The climate of the Kawartha Lakes system is described as humid continental and is located within the Simcoe-Kawartha Lakes climatic zone (KRCA 1982). Long term (1951-1980) annual precipitation is approximately 850 mm per year, and 20-25% of that falls as snow between November 1 and April 30 (Environment Canada 1981). Average daily temperature is 19.75°C for July and -8.85°C for January. Runoff depth is approximately 300 mm per year (Fisheries & Env. Canada 1978).

METHODS

The different components of the elemental budgets for Rice and Sturgeon Lakes are illustrated in Figs 6 and 7. Measurements of total phosphorus, chloride and potassium concentrations were made in small streams and major inflows and outflows as described in Hutchinson et al 1994b. Methods for estimating flow from these sources are described in Hutchinson et al 1994a. Loadings from point sources and shoreline development were estimated by staff of Central Region MOE (Jan Beaver, pers comm.) Measurement of precipitation volume is described in Hutchinson et al 1994a and estimation of loadings from precipitation is described in this report. Resuspension of phosphorus from sediments was estimated from laboratory measurements (Beak 1988). This source was not included in the mass balance so that phosphorus retention could be compared to values in the published literature. Retention of phosphorus in sediments was calculated as the residual term in the mass balance for phosphorus. Loss of phosphorus by fish harvest was estimated from creel survey data. Estimates of phosphorus loading from urban runoff were made according to standard techniques.

Runoff

Elemental loadings from surface runoff were calculated for three separate sources: major inflows and outflows, smaller streams and the unguaged portion of the immediate watershed. Loadings from the first two were calculated directly from measurements on gauged streams. Loadings from ungauged areas were estimated by prorating measured loads to the ungauged area on the basis of area ratios.

All loading calculations for gauged streams were based on daily estimates of total discharge and measurements of water chemistry which were made at intervals from twice daily to weekly (Hutchinson et. al 1994a&b). The total discharge for each day was multiplied by the average concentration for that day to obtain total daily load. Elemental concentrations for the periods between each sampling date were estimated by linear interpolation between adjacent concentrations. Calculations of daily load and summaries of total monthly load were derived by the 'STLOAD' minicomputer program at the Dorset Research Centre (Hutchinson and Snell, 1994)

In the Sturgeon Lake watershed the major inflows were monitored at Fenelon Falls and the Scugog River at Lindsay. Loadings from the immediate watershed were determined by monitoring McLaren, Hawkers, Martin, Rutherford and Emily Creeks (Fig 2). Discharge from Emily Creek was prorated from measurements made at Dunsford Creek and Emily Creek at Downeyville using the ratio of watershed areas (16,697/(2,772+2439) = 3.2042). Water chemistry was measured at the mouth of Emily Creek and used with the estimated flow to determine total loading.

The discharge from the ungauged portion, 19,032 ha (Table 2), of the Sturgeon Lake watershed was estimated by prorating discharge from the six smaller creeks (20,279 ha) on the basis of area ratios (0.9385, Hutchinson et al 1994a). Nutrient loading was not measured at the Emily at Downeyville site and so the nutrient load from the ungauged area was estimated by prorating the remaining five monitored streams at a ratio of 1.089.

The major inflow in the Rice Lake watershed was monitored at the mouth of the Otonabee River. Loadings from the immediate watershed were determined by monitoring the Indian and Ouse rivers and two small streams, Bewdley North and South, (Fig 3). The loadings from the ungauged portion (24,734 ha, Table 3) of the watershed were estimated by prorating loadings from the four smaller monitored watersheds on the basis of the ratio between gauged and ungauged area (0.43). Watershed areas and sample numbers used for input calculations to the Sturgeon and Rice Lake elemental budgets are shown in Tables 2&3.

Table 2: Watershed areas and sample numbers used for input calculations to the Sturgeon Lake elemental budget. All loading estimates were based on 1057 daily observations of discharge. 'n' denotes the number of chemistry measurements at each site and Stn ID's refer to the MOE laboratory information system(LIS).

Watershed	Area (ha)	n	LIS Stn I.D.	I.D. Code
Fenelon Falls	324500	163	17 0021 023 02	CA1
Scugog River	96370	477	17 0021 617 02	SG1,SGW,SG2
			17 0021 612 02	SG2
Emily Creek	16697	619	17 0021 121 02	EY1
McLaren Creek	5339	285	17 0021 124 02	ML1
Dunsford Creek	2439	453	17 0021 120 02	DH36
Rutherford Creek	1823	307	17 0021 125 02	RD1
Martin Creek	3437	367	17 0021 122 02	MN1
Hawkers Creek	4433	394	17 0021 123 02	HK1
Sturgeon Lake	4710	202	17 0021 (541-546) 02	SN6-11
Ungauged	19032			UNG
Bobcaygeon	476377	261	17 0021 021 02	BB1
Precipitation	4710*	36		Precip

*lake surface area

Table 3: Watershed areas and sample numbers used for input calculations to the Rice Lake elemental budget. All loading estimates were based on 1057 daily observations of discharge. 'n' denotes the number of chemistry measurements at each site and Stn ID's refer to the MOE laboratory information system(LIS)..

Watershed	Area (ha)	n	LIS Stn I.D.	I.D. Code
Otonabee R.	822530	446	17 0021 613 02	OT1
Indian R.	25800	400	17 0021 006 02	IR1
Ouse R.	28200	316	17 0021 120 02	OE1
Bewdley N.	631	335	17 0021 535 02	BYN
Bewdley S.	2220	338	17 0021 536 02	BYS
Rice Lake	10010	176	17 0021 (538-540) 02	RE33-36
Ungauged	24734			UNG
Trent River	914125	372	17 0021 067 02	TT1
Precipitation	10010*	36		Precip

*lake surface area

Precipitation

Loadings of TP, chloride and potassium were calculated as inputs directly to the surfaces of Rice and Sturgeon Lakes for each month of the study. Monthly totals were summed to produce seasonal and annual totals.

Monthly precipitation volume was calculated as the product of total monthly precipitation depth (m) and the surface area of the lake (m^2). Records of monthly precipitation depth were obtained from the Atmospheric Environment Service of Environment Canada for stations at Trent University in Peterborough (Peterborough-Trent, Stn.ID 6166455) for Rice Lake; and from the Frost Campus of Sir Sandford Fleming College in Lindsay (Lindsay - Frost, Stn.ID. 6164433) for Sturgeon Lake. The total monthly volumes of precipitation falling onto the surfaces of Rice and Sturgeon Lake over the three year study are presented in Figure 4.

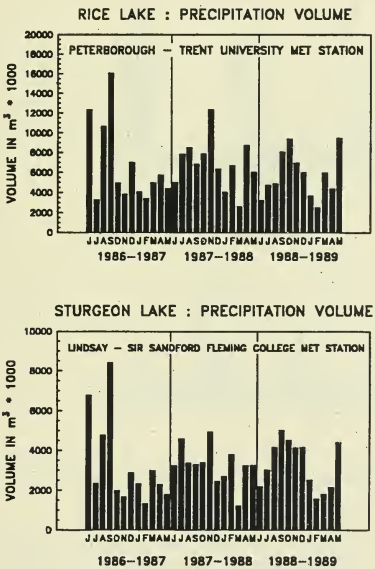


Figure 4: Monthly precipitation volumes to the surfaces of Rice and Sturgeon Lakes for 1986-87, 1987-88, and 1988-89.

Concentrations of total phosphorus, chloride and potassium in precipitation were obtained from the Ontario Ministry of the Environment - Acidic Precipitation In Ontario Study (APIOS) from the monitoring site in Uxbridge Ontario (immediately west of the study area). Precipitation was collected as 28 day cumulative wet only deposition into automated samplers (MOE 1985) and analyses were performed at the MOE Rexdale lab using standard procedures (MOE, 1988). Mean monthly concentrations of TP, chloride and potassium over the three year study are given in Figure 5.

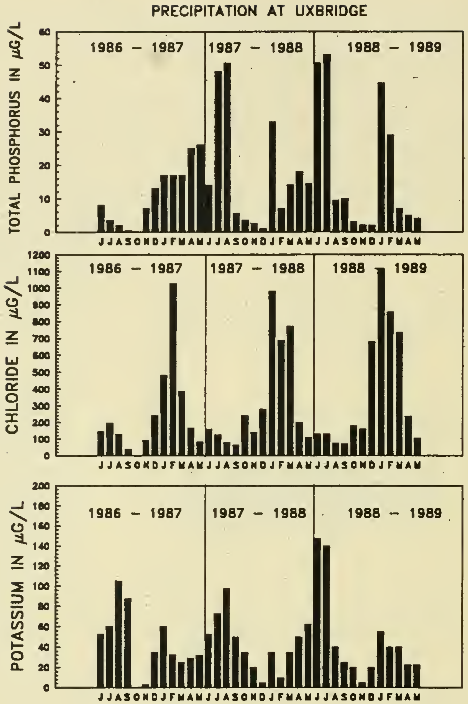


Figure 5: Monthly average concentrations of total phosphorus, chloride and potassium measured in precipitation at the Uxbridge monitoring station.

The Uxbridge meteorological station collected wet only deposition; dry deposition of phosphorus was not monitored at the site. The wet deposition of phosphorus was therefore converted into total (wet + dry) deposition using the wet:total ratio developed using data from the Dorset Research Centre meteorological station. Total phosphorus deposition at Dorset averages 20.7 +/- 1.5 mg.m $^{-2}$.yr (Dillon et al 1992). Wet deposition for 1986-1989 averaged 5.61mg.m $^{-2}$.yr (Dr. Neville Reid, Air Resources Br., MOEE, pers. comm.). The ratio of total:wet was 3.69:1. Wet only totals for Uxbridge were multiplied by this figure to estimate total atmospheric phosphorus deposition to the surfaces of Rice Lake and Sturgeon Lake.

Groundwater

The till plains that make up most of the Rice and Sturgeon Lakes study area are porous and deep enough to expect that groundwater recharge and discharge could contribute to the nutrient budget. However, groundwater was not explicitly considered in budget calculations due to the difficulty and expense involved in making accurate estimates over so large an area. Instead it was assumed that a) the groundwater contribution to each catchment was measured as the baseflow component of surface runoff and b) that for the lake basin itself, aquifer recharge and discharge would balance over the long term and that any errors associated with discounting their contribution would be insignificant. This assumption was validated by the close balance achieved for the hydrology budgets (Hutchinson et al 1994a) and the chloride budgets for each lake (Hutchinson et al 1994b).

Outflow

The outflows of Sturgeon and Rice Lakes were monitored at Bobcaygeon and the Trent River at Hastings respectively to determine the major loss components of the elemental budget. Methods of determining discharge and water chemistry at the outflows are given in Hutchinson et al 1994a and 1994b respectively. Loadings were calculated using daily discharge and average daily concentration as discussed in the previous section on runoff.

Storage

The storage contribution to the elemental budget was calculated as a function of changes in lake level and hence volume. The contribution of storage to the elemental budget was simply the product of hydrologic storage and the average concentration of TP, chloride or potassium measured at the lake outflow for that month. Average monthly concentrations and changes in hydrologic and elemental storage for Rice and Sturgeon lakes are summarized in Table 4. Storage of phosphorus in lake sediments was calculated as a separate budget element as the residual term in the mass balance equation, after in-lake storage had been corrected for hydrologic balance.

Balance, Retention and Export

The balance of each elemental budget was calculated as the total:
Balance = Total losses - Total Inputs + Storage

and as the percentage:
%Balance = 100 x Total losses / Total inputs - Storage

Figures 6 and 7 show the individual terms of the elemental budgets for each lake. Net retention of inputs was calculated for cases where the percentage balance was <100 (Inputs>Losses) and exports assumed where the balance was >100%.

Table 4: Average monthly total phosphorus concentrations and changes in water storage for Rice and Sturgeon Lakes, 1986-89. Phosphorus storage is calculated as the product of water storage and total phosphorus concentration for each month.

	Rice Lake			Sturgeon Lake		
Period	Water Storage ($x10^6$L)	Mean TP ($ug.L^{-1}$)	Phosphorus Storage (kg)	Water Storage ($x10^6$L)	Mean TP ($ug.L^{-1}$)	Phosphorus Storage (kg)
8606	-9090	24.8	-225.0	-1884	18.3	-34.4
8607	-2022	23.2	-46.8	471	11.0	5.2
6808	-3030	35.2	-106.7	-1884	15.0	-28.3
6809	7071	44.0	311.1	2355	15.2	35.8
8610	-13130	22.8	-299.4	-4239	17.8	-75.2
8611	4041	16.4	66.3	471	10.3	4.9
8612	-1011	16.3	-16.5	4710	11.7	55.0
8701	-4039	9.6	-38.8	-14600	7.5	-109.5
8702	3031	6.3	18.9	-8949	4.8	-42.5
8703	5049	12.1	61.2	14130	15.7	222.0
8704	6058	19.9	120.4	5652	11.3	63.9
8705	-1008	23.4	-23.6	3297	12.2	40.2
8706	-6061	18.4	-111.4	-1413	19.0	-26.8
8707	0	22.0	0	0	10.8	0
8708	5050	30.8	155.5	-471	14.3	-6.7
8709	-2019	46.5	-93.9	0	24.8	0
8710	-4041	30.8	-124.5	-471	13.5	-6.4
8711	0	23.0	0	941	11.0	10.4
8712	-3030	11.2	-33.9	-1413	10.7	-15.1
8801	3030	11.8	35.8	-7065	8.4	-59.3
8802	0	12.4	0	-6594	8.0	-52.8
8803	2020	15.7	31.7	8949	8.3	74.6
8804	10100	22.3	225.3	6123	13.0	79.6
8805	-5049	27.7	-139.8	0	11.4	0
8806	-4041	22.7	-91.7	-471	16.6	-7.8
8807	0	20.0	0	1413	16.2	22.9
8808	2020	27.8	56.2	-1413	13.3	-18.8
8809	-1009	46.2	-46.6	0	19.4	0
8810	-7071	29.2	-206.5	-1413	16.7	-23.5
8811	0	14.0	0	-1413	8.5	-12.0
8812	0	9.8	0	1884	10.0	18.8
8901	9090	12.7	115.1	-10360	7.4	-76.7
8902	-3030	12.4	-37.6	-6123	5.2	-31.8
8903	21210	15.8	335.1	23550	7.0	164.9
8904	-11110	21.6	-239.7	-4240	17.2	-72.9
8905	-4041	24.7	-99.9	-1413	14.8	-20.9

Sediments

Both release and retention of TP from lake sediments were considered in the nutrient budget.

Sediment release was estimated experimentally in 1987 by removing intact cores of sediment from Rice Lake, incubating them under controlled conditions and measuring the phosphorus release. Incubation under oxic conditions produced a release rate of 0.53 mg TP. m^{-2} .day^{-1}. The oxic release rate was considered valid because Rice Lake does not stratify. The potential contribution of sediment release to the TP load was calculated as the product of the release rate and the surface area of Rice Lake. Potentail phosphorus release was calculated for summer months only (May-Sept) with the assumption that both biologically and chemically mediated resuspension would be minimal at low temperatures. Full details of the experimental estimates are given in the project report by Beak Consultants (Beak Consultants 1994)

No experimental determinations of sediment phosphorus release were made for Sturgeon Lake. Instead, the release rate for Rice Lake was applied to the surface area of Sturgeon Lake to estimate the potential sediment contribution.

In spite of the release of phosphorous to the water column from sediments, lakes show a net retention of phosphorus on an annual basis through the sedimentation of particulate phosphorus. This retention was estimated from the phosphorus balance for each lake as the percentage of total loading which was lost from each lake (ie. Total inputs - total losses) The phosphorus balance was first corrected for hydrologic error by balancing the hydrologic budget to 100%. This ensured that the net balance for phosphorus was not biased by inaccuracies in the hydrologic budget. This corrected difference between inputs and losses represented that portion of the total load which was lost to the sediments.

The estimate of phosphorus released from the sediments was not included in the mass balance and retention calculations because, a) Published estimates for the Bay of Quinte (Minns et al. 1986) were an order of magnitude higher, b) Sediment reflux is likely insignificant in lakes which do not develop extended periods of anoxia (Nurnberg 1984) and c) published estimates of retention generally do not include an estimate of sediment reflux (Dillon et. al. 1986, Dillon and Evans 1992). The sediment contribution will be discussed in the final report (Hutchinson et. al. 1994d)

Shoreline Development

Nutrient inputs from shoreline development could not be measured directly. They were estimated as a function of the type and amount of development and the resulting phosphorus load. These techniques are described in the Land Use and Trophic Status Report of Ontario's Lakeshore Capacity Study (Downing, 1986, Dillon et.al. 1986) and were carried out by the staff at Central Region MOE (Jan Beaver pers comm.). The full shoreline development report is given in Appendix 6.

Development type and density were determined from assessment maps and assessment roll data for the townships and municipalities around each lake (Peterborough and Northumberland assessment offices, Sturgeon Point and Bobcaygeon Municipal offices). These assessment maps are not updated annually and dates of the most recent amendments varied from 1982 to 1987. The potential for discrepancy between recorded figures and actual development was addressed by a field survey of each lake in the summer of 1987. Field verification was performed by matching individual shoreline buildings to the assessment map, giving each lot and building a reference number and verifying the land use recorded in the assessment. Every twentieth building was photographed and described in detail to form a baseline for future changes. Lots serviced by the Bobcaygeon municipal sewers were omitted from the survey since their loadings were treated by the Bobcaygeon STP and discharged downstream of Sturgeon Lake. Buildings which were not on the assessment rolls were grouped logically with the existing land use on the basis of structure and landscaping. New buildings on land which was assessed as vacant were recorded as seasonal residential which was the major land use category for most development around both lakes. Total development is summarized in Tables 5 & 6.

No phosphorus loading was calculated for vacant lots. Their contribution was included as overland runoff in estimates of loading from the ungauged portion of each watershed. In estimates of future change developed for each lake, however, vacant lots were assumed to be developed as seasonal residences, using the appropriate phosphorus export. (Tables 5&6)

TP loads from each development unit were estimated based on usage (capita years/year), a per capita phosphorus load of 0.8 kg/year (Dillon et al 1986), and various estimates of phosphorus retention in septic fields. Seasonal residences and trailers at resorts were assigned a usage figure of 0.79 capita years per year ('weekend' usage, Downing 1986) and permanent residences a value of 2.55 ('all year' usage, Downing 1986). Cottages at resorts and commercial establishments were assigned an 'extended summer usage' figure of 1.27 (Downing 1986) and campsites 0.4. These values are summarized in Tables 5 & 6.

A standard usage value could not be assigned to resorts due to variability between resorts in terms of units, capacity and occupancy rates. Instead, resort owners recorded these figures on a questionnaire and a unique usage value was calculated for each resort.

In summary, phosphorus loads for each development type were calculated as:

No. of units x usage in capita yrs/yr x 0.8 kg P/capita/yr x (1-retention) = kg/yr.

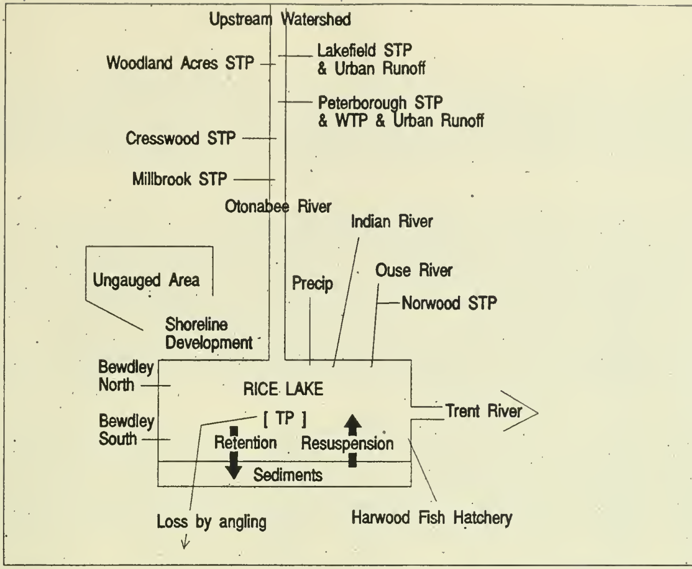


Figure 6: Schematic showing elements of the Rice Lake nutrient budget.

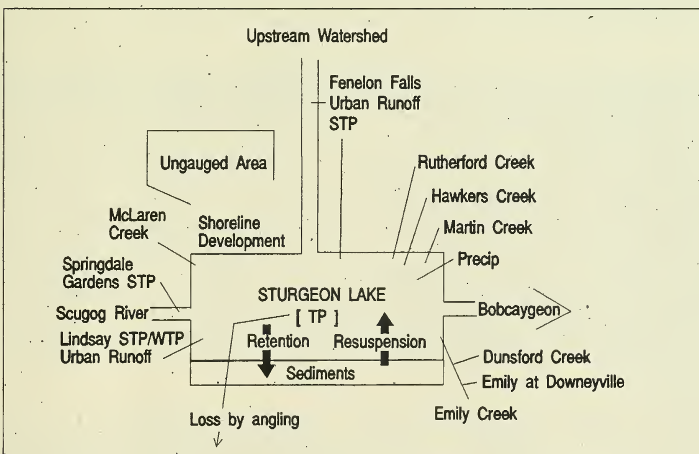


Figure 7: Schematic showing elements of the Sturgeon Lake nutrient budget.

Central Region completed four sets of nutrient loading estimates for shoreline development for each lake. The first calculation assumed no development of presently vacant land and the second predicted the loadings if each vacant lot were developed with a seasonal residential unit. The nutrient budget in the present report was calculated to reflect existing conditions by the first calculation (Tables 5 & 6).

The degree of phosphorus retention in shoreline septic fields was unknown so Central Region staff used two estimates for each lake. The worst case figure assumed that all phosphorus added to the septic field would migrate to the lake. The second estimate modified the phosphorus loading from resorts on the basis of data concerning the quality of the septic system and assumed some phosphorus retention (Table 7). The loadings from seasonal, permanent and commercial establishments were the same for both estimates. Application of the retention figure for resorts from the second method reduced the calculated loading of phosphorus from shoreline development. These estimates are presented in Figure 1 of Appendix 6.

The results of the Central Region shoreline survey showed several inconsistencies which advised against their direct use in the nutrient budget. First, four estimates were developed for each lake and second, phosphorus retention was assumed for resort units but not for permanent homes or seasonal residences. The Central Region figures were thus modified for use in the nutrient budget. Results are presented in Tables 5 and 6.

Cases 1&2 show the increase in phosphorus load projected as a result of developing vacant land into seasonal residences and assuming that all phosphorus will eventually move from the septic field to the lake. Case 2, showing full development, will be used in the final report (Hutchinson et. al 1994d) to explore various management alternatives.

In practice, soils may retain some of the phosphorus in a septic field so that one cannot assume that all phosphorus from present day shoreline development will immediately be expressed to the lake (Dillon et al. 1986, Dillon et al.1994, in press, Kortmann 1988). The Central Region study therefore estimated some degree of phosphorus retention from resorts, based on their survey of septic systems. Cases 3 and 4 (Tables 5 & 6) show estimated phosphorus loads with some phosphorus retention from all shoreline development. In the absence of detailed data, domestic septic fields were assumed to retain 74% of their phosphorus load. This retention figure assumes a properly functioning septic field with 15 inches of 0.24 mm sand plus 15 inches of a 50% mixture of clay and sand (Dillon et. al. 1986). The values for case 3 (vacant land undeveloped, some retention) were used to construct the budget of existing loads into each lake. It is acknowledged that, over time, retention will decrease and vacant lots will be developed as cottages. The assumption of some phosphorus migration was thus used as an estimate of existing conditions and should not be interpreted as representing a long-term condition.

Shoreline loading was also considered as a source of potassium and chloride for calculating those budgets. No data was available for these estimates so they were derived from the ratio of phosphorus/potassium/chloride for an STP which had no phosphorus removal.

Calculations, assumptions and final estimates of phosphorus loading to Rice and Sturgeon Lakes from shoreline development are given in Tables 5 & 6. Details of the shoreline development survey are presented in Appendix 6.

Table 5: Calculation of phosphorus loading to Rice Lake from shoreline development. See text for derivation of separate loading figures.

	Usage (capita yrs/yr)	TP load (kg/capita)	Number of units	Case 1 (kg TP)	Case 2 (kg TP)	Case 3 (kg TP)	Case 4 (kg TP)
Seasonal Dwellings	0.79	0.8	1120	708	708	184	184
Permanent Dwellings	2.55	0.8	191	390	390	101	101
Vacant Land	0.79	0.8	165	0	104	0	27
Commercial	1.27	0.8	7	7	7	2	2
Resorts			54				
-Cottages	1.27	0.8	590	600	600	432	432
-Trailers	0.79	0.8	1529	966	966	809	809
-Campsites	0.40	0.48	210	40	40	25	25
-Houses	2.55	0.8	20	41	41	30	30
-Commercial	1.27	0.8	24	24	21	21	21
Total Resort				1622	1622	1317	1317
Total			**3691**[1]	**2776**	**2880**	**1604**	**1631**

Case 1- Vacant land not developed, no septic field TP retention.
Case 2- Vacant land developed, no septic field TP retention.
Case 3- Vacant land not developed, unique retention coeff for each resort, retention = 0.74 for others.
Case 4- Vacant land developed, unique retention coeff for each resort, retention = 0.74 for others.

1= 3856 units if vacant lots developed as seasonal residences.

Table 6: Calculation of phosphorus loading to Sturgeon Lake from shoreline development. See text for derivation of separate loading figures.

	Usage (capita yrs/yr)	TP load (kg/capita)	Number of units	Case 1 (kg TP)	Case 2 (kg TP)	Case 3 (kg TP)	Case 4 (kg TP)
Seasonal Dwellings	0.79	0.8	1115	705	705	183	183
Permanent Dwellings	2.55	0.8	461	940	940	245	245
Vacant Land	0.79	0.8	188	0	119	0	31
Commercial	1.27	0.8	15	15	15	4	4
Resorts			17				
-Cottages	1.27	0.8	143	145	145	103	103
-Trailer	0.79	0.8	198	125	125	108	108
-Campsites	0.40	0.48	5	1	1	1	1
-Houses	2.55	0.8	8	17	17	12	12
-Commercial	1.27	0.8	10	11	11	9	9
Total Resort			364	299	299	233	233
Total			**1836**[1]	**1959**	**2078**	**665**	**696**

Case 1- Vacant land not developed, no septic field TP retention.
Case 2- Vacant land developed, no septic field TP retention.
Case 3- Vacant land not developed, unique retention coeff for each resort, retention = 0.74 for others.
Case 4- Vacant land developed, unique retention coeff for each resort, retention = 0.74 for others.

1 = 2024 units if vacant lots developed as seasonal residences.

Table 7: Assumptions made by Central region shoreline survey regarding retention of phosphorus in septic fields for resort units. Retention of 0 indicates no retention and 1.0 indicates full retention

Type of System	Condition		Retention (R_s)
Holding Tank	-working order		1.0
Holding Tank	-some leaking or occasional overflow		0.48
Holding Tank plus leaching pit for grey water			0.48
Septic Tank & Field	-working order sand fill in trenches		0.74
	-unknown	- case 1	0.0
		- case 2	0.48
	-poor condition		0.0
Leaching pit plus 45 gal drum sewers			0.0
Unknown			0.0
Combination			assume R_s for each component of system

Point Sources

Loadings of phosphorus, chloride and potassium from sewage treatment plants were calculated as the product of total monthly effluent discharge and average monthly concentration for each month of the study and summed to produce seasonal and annual totals. Concentrations and flows for each STP were provided by staff of Central Region, Ministry of the Environment (Jan Beaver, pers. comm.). Sampling frequencies and methods for estimating discharge varied for each STP and are presented below. The characteristics and capacities of individual STPs and WTPs are shown for Sturgeon Lake in Table 8a and for Rice Lake in Table 8b..

Sturgeon Lake Point Sources

The Lindsay STP is a series of 6 lagoons which discharge downstream of the town to a marshy area of Goose Bay on Sturgeon Lake. Loadings from that source were not, therefore, measured as part of the Scugog River load, but were added to the whole lake budgets. The volume of effluent inflow to the STP was recorded continuously as stage height in a Parshall flume and averaged 18,652 $m^3 \circ day^{-1}$. Monthly discharge was calculated as the product of average daily discharge and number of days in the month using figures given in MOE (1987). Concentrations of phosphorus, chloride and potassium were determined monthly before the spring of 1987, and weekly thereafter. Concentrations, volumes and loads are presented in Appendix 5, Table A5-1.

The Springdale Gardens STP is a continuously discharging lagoon which services a subdivision of 68 residences (204 people) in the Township of Ops, near Lindsay. The lagoon discharges by overflowing when full and there is no means of monitoring volume of discharge. Instead, the volume was estimated as 204 people x 100 imperial gallons $\circ$ person^{-1} $\circ$ day^{-1} (92.72 $m^3 \circ day^{-1}$). The lagoon discharges to the Scugog River downstream of Lindsay and these loads were added directly to the Sturgeon Lake budget. Estimates of average monthly phosphorus load were available for the period 1977-84 from the files of Central Region, MOE (Jan Beaver, pers. comm.). These estimates were based on 1-7 samples per year and produced an average effluent TP concentration of 1.53 $mg \circ L^{-1}$ and an average monthly load of 4.44 $kg \circ month^{-1}$. Chloride and potassium loads were estimated using loadings from the Lindsay STP, divided by the ratio of the population of Springdale Gardens to Lindsay (71.7). Phosphorus, chloride and potassium loads for the Springdale Gardens STP are given in Appendix 5, Table A5-2.

Table 8a: Summary of point sources of phosphorus to Sturgeon Lake from sewage and water treatment facilities.

Source	Receiver	Treatment	Design Capacity	Average Flow	Population	Effluent Objective mg/L TP
Lindsay STP	Scugog River at Goose Bay	6 continuous discharge lagoons 2 pre-aeration cells phosphorus removed via alum addition	17,183 m^3/d	18,652 m^3/d	14,636	1.0 - attained
Springdale Gardens	Scugog River 3 km upstream of Goose Bay	1 continuous discharge lagoon no phosphorus removal	8,740 m^3	92.7 m^3/d	204	1.0 occasionally exceeded
Fenelon Falls	Fenelon River upstream of Sturgeon Lake	continuous discharge oxidation ditch phosphorus removal by ferric chloride (<8703) and alum addition (>8703)	1,000 m^3/d	859 m^3/d*	1,798*	1.0 occasionally exceeded
Lindsay WTP	Scugog River at Mary Street	backwashing of 5 filters every 24 hours	--	227.3 m^3/d	14,636	none

*From MOE, 1987. Report on the 1986 Discharges from Municipal Wastewater Treatment Facilities in Ontario. ISSN 0835-7552, Oct. 1987.

The Fenelon Falls STP is a continuously discharging oxidation ditch. Phosphorus was removed by ferric chloride addition before March of 1987 and by alum addition thereafter. It discharges to the Fenelon River between Cameron and Sturgeon Lakes and was therefore considered as a direct source of phosphorus to Sturgeon Lake. Inflow volumes were obtained from the 1986 MOE report of discharges from municipal STPs (MOE, 1987) on the basis of continuous recordings from a V-notch weir. Phosphorus concentrations were determined from a monthly 6 hour composite sample prior to the spring of 1987, and from weekly composites thereafter. Chloride and potassium concentrations were determined from monthly composite samples made between October 1986 and December 1988. Concentrations for April-September 1986 and January-May 1989 were estimated from monthly averages from the period of measurement. During peak flow periods raw sewage occasionally bypassed the STP (Jan Beaver, Central Region, MOEE, pers. comm.) but it was not possible to estimate the loading from these bypasses. Phosphorus, potassium and chloride loadings and calculations are given in Appendix 5, Table A5-3.

The Lindsay WTP discharges small amounts of phosphorus, chloride and potassium to the Scugog River by the daily backwashing of five filters at the Mary St. facility. The total volume of backwash water added to the Scugog River averaged 227,300 L/day. Backwash water was sampled monthly between October 1987 and February 1989. On each date water was sampled every 5 minutes during the 25 minute backwash period and a single composite sample was analyzed for TP, chloride and potassium. These concentrations were also used for the periods of April 1986 - September 1987 and March - May 1989. Backwash water also contained background phosphorus, chloride and potassium from the Scugog River. The monthly backwash concentrations were thus corrected by subtracting the average monthly concentrations of the three elements in the Scugog River; to obtain the concentrations added by backwashing. Monthly loads were determined by multiplying this corrected concentration for each month by the total backwash volume for that month (227,300 L/day x number of days/month). These loads were included as point source contributions to the Scugog River and measured as part of the Scugog River load. Calculations and loads for phosphorus, potassium and chloride are given in Appendix 5 Table A5-4a-4c.

Rice Lake Point Sources

The Peterborough STP discharges to the Otonabee River below the City of Peterborough. Loadings from that source were not, therefore, included as direct inputs to Rice Lake but were part of the load measured at the mouth of the Otonabee River at Campbelltown. The Peterborough STP consists of a conventional, extended aeration, activated-sludge plant with continuous phosphorus removal using ferric chloride. It discharges to the Otonabee River by way of submerged outfall diffusers. Outflow volume is monitored by continuous recording of stage height in Parshall flumes. For calculation purposes, average daily flows were taken from the report of 1986 discharges from municipal wastewater treatment facilities in Ontario (MOE, 1987). TP concentrations were determined from 24 hour composite samples taken Monday to Friday each week. Chloride and potassium concentrations were determined monthly in 1988 and these concentrations were used for the entire period of study. TP concentrations were analyzed by staff of the City of Peterborough at the STP. Duplicate samples taken once per month for analysis by MOE staff at the Rexdale laboratory plus a quality control check run by the International Joint Commission and Environment Canada (10 samples of known concentrations over 4 years), confirmed that the Peterborough analyses were accurate. Loadings and concentrations are summarized in Appendix 5, Table A5-5.

The Millbrook STP discharges to Baxter Creek which flows into the Otonabee River below the City of Peterborough. Its load was therefore included in the values measured at the mouth of the Otonabee River. The volume of effluent was monitored continuously as stage height in a Parshall flume. For calculation purposes, average daily flows were taken from the report of 1986 municipal discharges (MOE, 1987). Concentrations of TP were determined from 24 hour composite samples taken monthly throughout the study. Chloride and potassium concentrations were determined from 24 hour composite samples taken monthly from January 1989 to April 1990, and used as monthly values throughout the course of the study. Loadings and concentrations are summarized in Appendix 5, Table A5-6.

The Lakefield STP consists of 2 aerated lagoons which are discharged to the Otonabee River below Lakefield up to 4 times per year, usually in the spring and fall. Inflow to the lagoons is monitored continuously with a magnetic flow meter. Phosphorus loads from these lagoons were provided by Central Region staff (J. Beaver, pers. comm), based on at least 4 samples from each discharge period. Potassium and chloride concentrations were measured 9 times at irregular intervals over the three year period of the study. These concentrations were averaged and used with monthly inflow volumes from the report on 1986 municipal discharges (MOE, 1987) to estimate potassium and chloride loads on a month to month basis. All loadings and concentrations are presented in Appendix 5, Table A5-7.

Table 8b: Summary of point sources of phosphorus to Rice Lake from sewage and water treatment facilities. All figures were provided by Central Region, MOE, unless noted otherwise.

Source	Receiver	Treatment	Design Capacity	Average Flow	Population	Effluent Objectives mg/L TP
Peterborough STP	Otonabee River	extended aeration, activated sludge with TP removal via ferric chloride addition	54.55 x $10^3 m^3$/d*	53.2*-55.7x$10^3 m^3$/d	61,063	1.0exceeded occasionslly
Millbrook STP	Baxter Creek to Otonabee River	extended aeration with TP removal	1136 m^3/d	904 m^3/d	925*	1.0 met consistently
Lakefield STP	Otonabee River	aerated lagoons discharging 1-4 times per year**	1591 m^3/d	1278*-1477 m^3/d	2,324	1.0 exceeded occasionally
Norwood STP	Ouse River below Norwood	oxidation ditch with activated sludge and continuous phosphorus removal	727 m^3/d	463*-559 m^3/d	1,103	1.0 exceeded occasionally
Cresswood STP	Jackson's Creek and Otonabee River	stabilization pond, no removal	52.51 x $10^3 m^3$	26.25 x $10^3 m^3$ twice per year	1,100	1.0 exceeded occasionally
Woodland Acres STP	Bear Creek and Otonabee River	extended aeration, modified activated sludge, no P removal	363 m^3/d	247*-329 m^3/d	435*	1.0 exceeded frequently
Peterborough WTP	Otonabee River	Backwashing from 11 filters	--	493 x $10^3 m^3$/yr	61,063	n/a
Harwood Fish Hatchery	Rice Lake	settling pond	--	7632 m^3/d	--	--

* Figures from MOE, 1987. Report on the 1986 discharges from municipal wastewater treatment facilities in Ontario. ISSN 0835-7552. October 1987.
**Will become continuous discharge in 1994. New capacity unknown (J. Bourque, Peterborough MOE, pers comm)

The Norwood sewage treatment facility is an oxidation ditch with activated sludge and continuous phosphorus removal. It discharges to the Ouse River downstream of the village of Norwood and is therefore included in the measured load from the Ouse River. Inflow volume was continuously recorded with a magnetic flow meter and TP was derived from 24 hour composite samples taken three times per month. Chloride and potassium were determined monthly in 1987 and 1988 and used with monthly discharge figures from the 1986 municipal discharge report to estimate monthly loads. Loadings and concentrations are given in Appendix 5 Table A5-8.

The Cresswood facility is a 3.6 acre waste stabilization pond servicing a secondary school. It is discharged in spring and fall into a drainage ditch which empties into Jackson's Creek, and ultimately, the Otonabee River below Peterborough. Its load to Rice Lake was included in the loads measured at the mouth of the Otonabee River. There were no measurements of discharge available for the Cresswood STP. Central Region staff (Jan Beaver, pers. comm.) provided estimates of 17.8 kg $\circ$ yr^{-1} of TP load at an average effluent concentration of 0.34 mg $\circ$ L^{-1} based on one measurement made during each discharge event. This load was split into equal discharges of 8.9 kg (26,176 m^3) in April and October of each year. Chloride and potassium loads were estimated using ratios of phosphorus/chloride and phosphorus/potassium from the Lakefield lagoons. These were the only comparisons available and do not account for the fact that Lakefield has phosphorus removal while Cresswood does not. Loadings from the Cresswood facility are summarized in Appendix 5, Table A5-9.

The Woodland Acres (Smith Township) STP discharges to Woodland Acres (Bear) Creek and ultimately to the Otonabee River. Its load to Rice Lake is included in measurements at the mouth of the Otonabee River. Inflow volume was estimated by recording timers on effluent pumps. Monthly measurements of TP were made and combined with flow data by Central Region staff to produce monthly estimates of TP load (J. Beaver, pers. comm.). Chloride and potassium were measured twice monthly in 1989 and 1990 and used with monthly estimates of flow from the 1986 report on municipal discharges (MOE, 1987) to estimate loads. Loadings and concentrations are presented in Appendix 5 Table A5-10.

The Peterborough WTP discharges phosphorus, chloride and potassium to the Otonabee River from the backwashing of filters. There are a total of 11 filter beds in two plants and total annual discharge of backwash water averaged 493,000 m^3 over the three year study. Backwash frequency increases when high levels of suspended solids require the use of poly-aluminum-chloride as a flocculant. Filters were thus backwashed every 8-24 hours in the summer and every 4-5 days in winter. A total of 1928 and 1880 backwash events took place in each of 1987 and 1988 and total monthly volumes of backwash water are presented in Appendix 5 Table A5-11. Backwash water quality was measured at the beginning and end of a single backwash event in each month from December 1987 to November 1988. Most events lasted 5 minutes but several lasted 10 and were sampled at 5 and 10 minutes. Monthly total flows were divided into volumes corresponding to 0-1 and 2-5 minutes for 5 minute events and 0-1, 2-6 and 7-10 minutes for 10 minute events.

These flows were multiplied by the concentrations measured at 5 or 10 minutes and the intervals summed to produce the total load generated each month. Background loads were determined using monthly flow through the WTP and concentrations measured upstream of Peterborough at the provincial water quality monitoring network station on the Otonabee River (Stn. 17-0021-013-02) in 1988 and 1989. Monthly background loads were subtracted from the WTP total to estimate the load contributed by the WTP. Concentrations and loads are summarized for each month in Appendix 5 Table A5-11.

The Harwood fish hatchery is operated by the Ontario Ministry of Natural Resources and is located near the mouth of Goose Creek on the south shore of Rice Lake. Total flow of Goose Creek through the hatchery is 7,632 m^3 o day^{-1}; of which 7,362 m^3 o day^{-1} passes through the hatchery raceway. The remaining 270 m^3 pass through the hatchery to a settling pond where solids are removed (MNR, H. Hickley, pers. comm.). Staff from Central Region of MOE (Jan Beaver, pers. comm.) conducted a program of monthly water quality sampling in 1988. Samples were collected in Goose Creek above the hatchery, at the outflow from the raceway and the discharge from settling pond. The sampling program was focused on phosphorus, nitrogen and BOD and no chloride or potassium concentrations were available. Total phosphorus load from the Harwood Hatchery was calculated as:

TP concentration from the effluent pond x 270,000 L o day^{-1}
+TP concentration from the raceway x 7,362,000 L o day^{-1}
- TP concentration upstream in Goose Creek x 7,632,000 L o day^{-1}

Daily loads were multiplied by the number of days in each month to estimate monthly loads. Concentrations and loads are summarized in Appendix 5, Table A5-12a&b.

Phosphorus Removal by Fish Harvest

Several commercial licences exist for harvest of carp in Rice Lake, but elevated PCB concentrations do not allow the sale of these fish and so none are harvested. Both Rice and Sturgeon Lakes support significant sport fisheries. The Rice Lake fishery is the largest and creel surveys indicate that the annual harvest is 10 times greater than in Sturgeon Lake. The size of the fisheries suggest that fish harvest could potentially represent significant phosphorus removal from the system. Creel survey data was compiled by the Kawartha Lakes Fisheries Assessment Unit of the Ministry of Natural Resources (D. Maraldo, pers. comm.) for the May to November period for 1987 (Rice Lake) and 1988 (Sturgeon Lake). Monthly fish harvest (kg wet weight) was converted to kg of phosphorus by assuming 4% phosphorus content for dry fish (Kitchell et al. 1975) and a ratio of 4:1 for wet to dry weight conversion (H. Harvey, Univ. of Toronto, pers. comm, cited from Dillon et al. 1986). Figures for harvest biomass and phosphorus removal for each month are given in Table 9.

Table 9: Estimates of phosphorus removal by harvest of fish from Rice and Sturgeon Lakes

	Rice Lake		Sturgeon Lake	
	Harvest (net kg)	Phosphorus (kg)	Harvest (net kg)	Phosphorus (kg)
May	33,419	334	2,799	28
June	54,157	542	4,538	45
July	41,265	413	3,463	35
August	17,336	173	1,456	15
September	20,220	202	1,696	17
October	2,052	21	170	1.7
November	135	1.4	11	0.1
Total	**168,584**	**1,348**	**14,136**	**142**

Urban Runoff

Runoff from developed urban areas was considered as a source of phosphorus to Rice and Sturgeon Lakes. Lindsay and Fenelon Falls contributed phosphorus to the Scugog River and Sturgeon Lake. Peterborough and Lakefield contributed phosphorus to the Otonabee River and hence to Rice Lake.

Preliminary estimates suggested that urban runoff accounted for only 1% of the total load and it was not considered necessary to monitor and sample urban runoff as part of the field program (pers. comm., Wan Wong, Water and Wastewater Management Section, MOE, January 10, 1986). Loads were estimated on the basis of average conditions in other urban catchments in Ontario, using the following equations from the American Public Works Association.

1. Gross areas (GA) and populations (Pop) were taken from the municipal directories of 1982 for each of the four urban areas.

2. Developed area (DA) was calculated as:

$$\mathbf{DA = GA \times (1-(e^{(-0.0688 \times (Pop/GA))}))}$$

Ref: Sullivan et al. 1974

3. Sewered Area (SA) was calculated as:

SA = 0.737 x DA if DA/GA <45%; **SA = 0.85 x DA** if otherwise.

Ref: Sullivan et al. 1974

4. Unsewered Area (UA) = **DA-SA**

5. Imperviousness (IM, %) =

$$\mathbf{100 \times [0.096 \times [(Pop/(DA \times 2.47)^{(0.59 - (0.0391 * \log (Pop/DA)))}]}$$

Ref: Sullivan et al. 1974

6. Precipitation (P) = **Precipitation in mm for Peterborough**

7. Runoff (mm/yr) = **(0.15 + (0.75 x IM/100)) x P**

Ref: Sullivan et al. 1974

8. TP concentration = **0.2 mg/L.** (Results for Guelph North)

Ref: COA Report No. 94, page 8 (Walker & Novak, 1975)

Imperviousness figures were used to calculate runoff from sewered areas. Runoff from unsewered areas was 122 $mm \circ yr^{-1}$ for all urban areas (0.15 x Precip). Runoff was calculated as runoff depth x area for both sewered and unsewered areas and multiplied by the TP concentration of 0.2 $mg \circ L^{-1}$ to determine TP load. The phosphorus concentration was from a study in Guelph, a similar urban area in Southern Ontario. Calculations and total loading figures are summarized in Table 10.

Total annual loading was prorated to monthly loading by adjusting the annual load (kg) by the proportion of the total annual precipitation which fell in each month. Monthly loadings are summarized in Table 11.

Table 10: Estimated annual inputs of phosphorus to Rice and Sturgeon Lakes from urban runoff. Areal load was calculated as total load/developed area.

	Fenelon Falls	Lindsay	Lakefield	Peterborough
Area (ha)				
Gross	238	1528	293	5,322
Developed	90	713	122	2,918
Sewered	67	606	90	2,480
Unsewered	24	107	32	438
Population	1,649	13,950	2,302	61,470
Developed Area Population Density (#/ha)	18	20	19	21
Imperviousness (%)				
Sewered Area	28	29	29	30
Unsewered Area	0	0	0	0
Precipitation (mm)	813	813	813	813
Runoff depth (mm)				
Sewered Area	295	301	297	308
Unsewered Area	122	122	122	122
Runoff volume (m^3)				
Sewered Area	195,973	1,821,980	268,017	7,626,718
Unsewered Area	28,943	130,364	39,240	533,747
Phosphorus Load (kg)				
Sewered Area	39	364	54	1,525
Unsewered Area	6	26	8	107
Total	**45**	**390**	**62**	**107**
Areal Load ($mg.m^{-2}yr^{-1}$)	50	55	51	56

Table 11: Monthly loadings of phosphorus to Rice and Sturgeon Lakes from runoff in four urban centres. Monthly loadings were assumed identical in each year of the study.

		Fenelon Falls	Lindsay	Lakefield	Peterborough
Total Annual Load (kg)		45	390	62	1632
Monthly	% Annual Precip	TP in kg	TP in kg	TP in kg	TP in kg
January	5.0	2.3	19.5	3.1	81.6
February	5.4	2.4	21.1	3.3	88.1
March	5.8	2.6	22.6	3.6	94.7
April	8.1	3.6	31.6	5.0	132.2
May	8.6	3.9	33.5	5.3	140.4
June	8.8	4.0	34.3	5.5	143.6
July	6.9	3.1	26.9	4.3	112.6
August	10.3	4.6	40.2	6.4	168.1
September	13.3	6.0	51.9	8.2	217.1
October	9.5	4.3	37.1	5.9	155.0
November	9.9	4.5	38.6	6.1	161.6
December	8.3	3.7	32.4	5.1	135.5

RESULTS

Rice Lake: Hydrology Budget

A detailed presentation of the Rice Lake hydrology budget was given in the hydrology volume of the Rice-Sturgeon Lake series (Hutchinson et al. 1994a). Key findings are presented here to relate the hydrology and nutrient budgets.

Overall balance of the Rice Lake hydrology budget was negative in each year of the study, when expressed as:

Output - (Input + Storage)

Supply terms exceeded loss terms by 8.7, 3.5 and 4.4%) in 1986-87, 1987-88 and 1988-89, respectively (Table 12, Fig. 8).

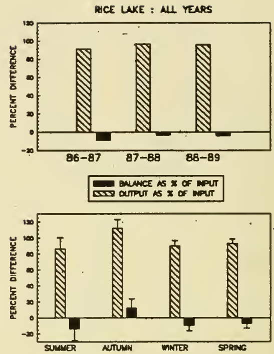


Figure 8: Annual and seasonal hydrology budget for Rice Lake 1986-87,1987-88,1988-89.

Table 12: Annual balance of the Rice Lake hydrology budget, 1986-87, 1987-88, 1988-89. All values are ($m^3 \times 10^6$)

Supply terms	1986-1987	1987-1988	1988-1989
Bewdley North	2.0	1.9	1.7
Bewdley South	3.6	4.3	3.5
Ouse River	83.1	64.2	45.6
Indian River	84.3	73.4	5.6
Otonabee River	3280	2233	2100
Ungauged	75.3	62.6	55.0
Precipitation	80.8	83.0	69.3
Total	3609	2522	2351
Loss terms			
Trent River outflow	3246	2366	2181
Evaporation	56.6	68.0	64.2
Total	3303	2434	2245
Storage	-8.1	0	2.0
Balance (out-in + storage)	-314.5	-88.4	-103.5
% (out/in - storage)	91.3	96.5	95.6
Adjustment for 100% balance	1.095	1.036	1.046

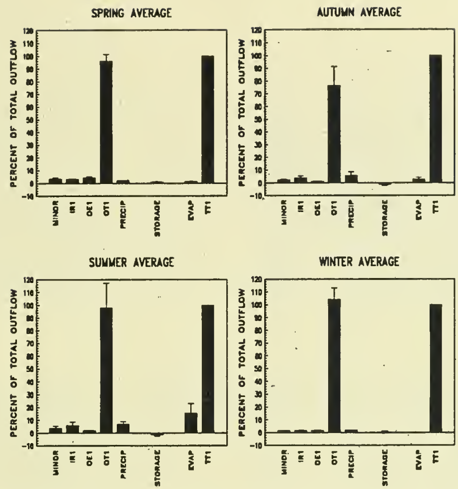


Figure 9: Average seasonal hydrology budget for Rice Lake. All figures given as percent of total outflow.

Loss terms exceeded supply terms only in the autumn of 1987-88 and 1988-89. The hydrologic budget was dominated by the Otonabee River, which provided over 80% of the water to Rice Lake in each season (Fig. 9). The remaining supply was provided by the minor tributaries and ungauged areas, and precipitation input was only significant in summer and autumn. Evaporation losses were significant (≈15% of loss) only in the summer.

The hydrology balance was poorest in June 1988 (56%) and March of 1989 (159%). Seasonal balance was poorest in the summer of 1988 (75%) and autumn of 1988 (120%, Table 13). Annual balances were adjusted so that total loss equalled total supply in order to adjust the elemental and nutrient budgets for flow. Total outflows were multiplied by 1.1, 1.04 and 1.05 for 1986-87, 1987-88 and 1988-89, respectively (Table 14).

Table 13. Seasonal balance of the Rice Lake hydrology budget for 1986-87, 1987-88, 1988-89.

Supply terms (m3 x 10E6)

	1986-1987				1987-1988				1988-1989			
	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr
BYN	0.51	0.49	0.45	0.59	0.32	0.41	0.59	0.63	0.31	0.37	0.45	0.57
BYS	0.57	0.76	0.78	1.46	0.53	0.49	0.95	2.37	0.44	0.48	1.43	1.11
OE1	8.9	12.6	13.5	48.1	4.6	2.8	17.3	39.5	5.0	2.1	6.5	32.0
IR1	16.9	21.0	15.0	31.4	15.2	15.4	15.9	26.9	17.7	18.0	9.8	30.1
OT1	577	1031	801	872	181	217	874	962	228	301	637	935
UNG	11.7	15.2	12.9	35.5	9	8.3	15.1	30.2	10.2	9.1	7.9	27.8
Precip	26.3	24.9	14.5	15.1	21.3	27.1	17.1	17.4	12.9	24.4	12.2	19.8
TOTAL	642	1106	858	1004	232	271	941	1079	274	356	675	1046

Loss terms

TT1	493	1093	776	883	195	312	911	948	165	424	562	1030
Evap	37.4	10.8	0.0	8.5	43.6	12.2	0.0	12.2	43.5	12.7	0.0	8.0
TOTAL	530	1104	776	892	239	324	911	961	208	437	562	1038
Storage	-14.1	-2.0	-2.0	10.1	-1.0	-6.1	0.0	7.1	-2.0	-8.1	6.1	6.1
Balance	-126	-4	-84	-102	6	47	-30	-111	-68	73	-107	-2
% of Loss	80.8	99.6	90.3	89.7	102.6	116.8	96.8	89.7	75.4	120.0	84.0	99.8

Table 14: Net annual phosphorus retention in Rice Lake for 1986-87, 1987-88, 1988-89.

	% Hydrology Balance (uncorr)	Correction Factor (100/balance)	%Phosphorus Balance (uncorr)	%Phosphorus Balance (corr)	% Phosphorus Retention (100-corr.bal.)	%Water Yield (Runoff/precip)
1986-1987	91.3	1.095	86.0	94.2	5.8	44.4
1987-1988	96.5	1.036	68.2	70.7	29.3	31.5
1988-1989	95.6	1.046	70.1	73.4	26.6	34.8

Rice Lake: Phosphorus Budget

The total measured phosphorus load to Rice Lake from all sources was 80.5, 68.1 and 64.1 tonnes in 1986-87, 1987-88 and 1988-89, respectively (Table 15, Fig. 10). Total measured losses at the Hastings outflow were 69.3, 46.5 and 45.1 tonnes for the same period. The balances of the Rice Lake phosphorus budget were thus 86, 68 and 70% for each year of the study, when losses were expressed as percentage of all inputs, adjusted for storage terms (Table 15).

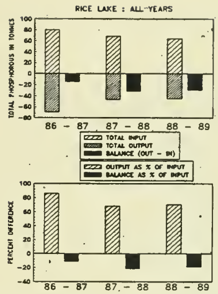


Figure 10: Total annual phosphorus budget for Rice Lake for 1986-87, 1987-88, 1988-89.

The annual phosphorus balance was adjusted for flow by multiplying the 3 annual percentage balances by factors of 1.1, 1.4 and 1.05, the factors used to adjust flow so that total losses were equal to total inputs (Table 14). The resultant figures showed that 94%, 71% and 73% of the TP load to Rice Lake was exported downstream after accounting for error in the hydrologic balance (Figure 11). Retention (100 - adjusted export) was thus 6%, 29% and 27% in each study year (ave. = 21%). Low retention in year one was the result of higher flow and higher water yield. Water yields (runoff/precipitation) were 44%, 32% and 35% in each of the three study years.

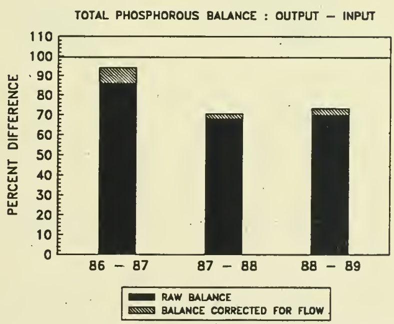


Figure 11 : Annual phosphorus balance for Rice Lake for 1986-87, 1987-88, 1988-89.

Phosphorus loads to Rice Lake were highest in the spring, averaging 29.0 ± 3.5 tonnes for the three months of spring over the course of the study. Summer loads averaged 14.1 ± 5.2 tonnes, winter loads 15.4 ± 3.6 and autumn 11.7 ± 9.4 tonnes (Table 16).

Table 15: Annual balance of the Rice Lake phosphorus budget for 1986–87, 1987–88, 1988–89. All values in kg unless otherwise noted. Sediment contributions are not included in balance estimates.

Supply terms

	1986–1987	1987–1988	1988–1989
Bewdley North	85	87	81
Bewdley South	318	1429	594
Ouse River	1907	2024	1961
Indian River	2145	1742	2022
Otonabee River	69378	53158	51987
Ungauged	1937	2297	2026
Precipitation	2808	5560	3616
Harwood STP	151	151	151
Sediment	8170	8170	8170
Shoreline	1604	1604	1604
TOTAL	80461	68139	64148

Loss terms

Trent River	67967	45149	43785
Fish Harvest	1348	1348	1348
TOTAL	69315	46497	45133

Storage	−177	−55	−214
Balance (kg) (Out−In+Storage)	−11323	−21697	−19229
Balance (%) (Out/In−Storage)	86%	68%	70%

Table 16: Relationships between phosphorus and water loads for Rice Lake, 1986-1989. Total loading figures are average values from all sources over the 3 year study. Regressions were calculated using monthly loadings grouped for each season.

	Three Year Average				
	Phosphorus Load (Tonnes)	Water Load ($m^3 \times 10^6$)	Equation	r^2	*p*
Summer	14.1 ± 5.3	383 ± 226	Load = 0.025(flow) + 1.47	.94	<0.00001
Autumn	11.8 ± 9.4	578 ± 460	Load = 0.018(flow) + 0.493	.93	<0.00003
Winter	15.4 ± 3.6	825 ± 136	Load = 0.009(flow) + 2.585	.06	<0.511
Spring	29.0 ± 3.5	1043 ± 38	Load = 0.016(flow) + 4.216	.57	<0.02

Phosphorus loads were higher per unit of flow in summer, compared to other seasons (Figure 12, Table 26). Although part of this increase could be attributed to seasonal shoreline residences, regressions showed that the relationship between water and phosphorus inputs was strongest during summer and autumn over all 3 years, suggesting that other sources in the watershed were important. Further evidence of higher loading in summer is given by the slope of the line relating water load to phosphorus load, which was 50% higher in summer than in other seasons (Table 16).

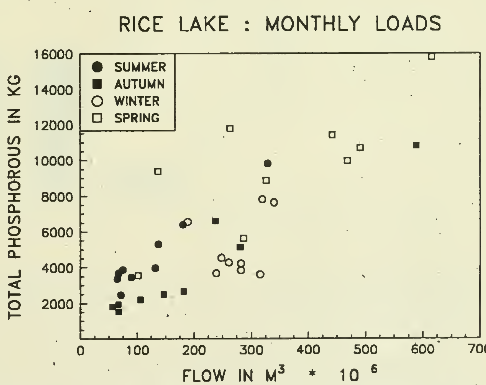


Figure 12: The relationship between monthly hydrologic and total phosphorous loads for Rice Lake.

On average, autumn losses were 127% of supply, showing a net export of phosphorus from Rice Lake (Table 17, Figure 13). Autumn phosphorus export ranged from 19-32 % of loads in each year of the study (Table 17a) while retention ranged from 26-38% in the other three seasons. Export was most pronounced in September and October of each year. Export was lower in November and also in August of year 1 (Table 17a)

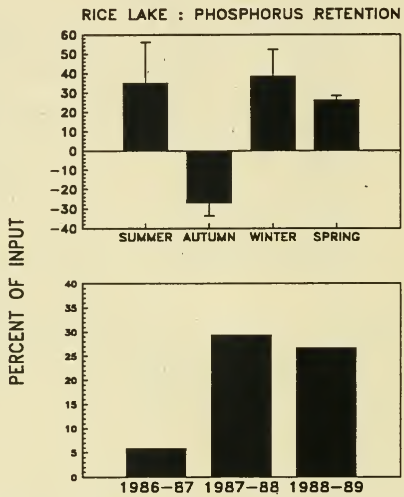


Figure13: Seasonal and annual phosphorus retention in Rice Lake as a percent of total input

Autumn export or balance of TP may reflect flushing of summer algal growth by the increased water load from summer to autumn (Table16), an autumn release of TP from decomposing macrophytes or a shift from diatoms to blue green algal dominance in the autumn. Blue-green algae float on senescence unlike diatoms which sink. Thus the mid summer diatom community would be retained in the Rice lake sediments while the TP associated with the autumn blue green community would be measured as export as it flushed from the lake at Hastings. In remaining seasons, 62-74% of the phosphorus supply was exported (or 26-38% was retained). Retention was similar in summer and winter. Lower retention in spring likely reflected higher hydrologic loading.

Table 17a: Seasonal phosphorus retention in Rice Lake for 1986-87, 1987-88, 1988-89.

	% Hydrology Balance (uncorrected)	Correction Factor (100/Balance)	% Phosphorus Balance (uncorrected)	% Phosphorus Balance (corrected)	% Phosphorus Retention (100 - corr. bal.)
Summer	86.3 (14.4)	1.179 (0.183)	55.3 (15.5)	65.2 (21.3)	34.8
Autumn	112.1 (11.0)	0.898 (0.093)	142 (9.9)	126.9 (6.7)	-26.9
Winter	90.4 (6.4)	1.11 (0.08)	55.7 (13.1)	61.6 (13.8)	38.4
Spring	93.1 (5.8)	1.077 (0.065)	69.0 (6.2)	74.1 (2.4)	25.9
Autumn 1986	99.62	1.004	131.5	132.0	-32
Autumn 1987	116.78	0.856	151.1	129.4	-29
Autumn 1988	120.05	0.833	143.2	119.3	-19

% Phosphorus Retention (<0=export)

	Aug	Sept	Oct	Nov
1986	-14.1	-38.3	-27.8	-0.3
1987	51.8	-33.7	-25.7	-26.6
1988	69.4	-42.5	-31.8	-6.7

Table 17b: Seasonal balances of the Rice Lake phosphorus budget for 1986–89.
All values in kg unless noted. Sediment contributions were not included in balance calculations.

	1986-1987				1987-1988				1988-1989			
	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr
Supply terms												
Bewdley North	25	12	22	25	14	15	28	29	16	21	23	21
Bewdley South	66	51	34	166	22	65	441	901	25	22	421	127
Ouse River	320	223	152	1212	168	44	378	1434	204	33	165	1559
Indian River	891	320	183	751	488	218	280	756	354	207	216	1245
Otonabee River	17266	21154	10628	20330	6135	4618	16879	25526	7995	5576	12549	25867
Ungauged	567	264	170	937	301	149	490	1357	260	123	359	1284
Precipitation	508	135	844	1321	3379	372	722	1086	1788	475	963	391
Harwood STP	54	36	28	34	54	36	28	34	54	36	28	34
Sediment	4881	1645	0	1645	4881	1645	0	1645	4881	1645	0	1645
Shoreline	447	416	355	386	447	416	355	386	447	416	355	386
TOTAL	20145	22610	12416	25160	11007	5933	19603	31508	11143	6907	15078	30914
Loss terms												
Trent River	13964	29499	8729	15775	4758	9148	10420	20823	3805	10109	6637	23234
Fish Harvest	902	179	0	267	902	179	0	267	902	179	0	267
TOTAL	14866	29678	8729	16042	5660	9327	10420	21090	4707	10288	6637	23501
Storage	-375	77	-36	157	44	-216	2	116	-35	-251	77	-4
Balance (kg) (Out–In+Storage)	-5654	7145	-3723	-8962	-5304	3177	-9181	-10302	-6471	3130	-8364	-7417
Balance (%) (Out/In–Storage)	72%	132%	70%	64%	52%	151%	53%	67%	42%	143%	44%	76%

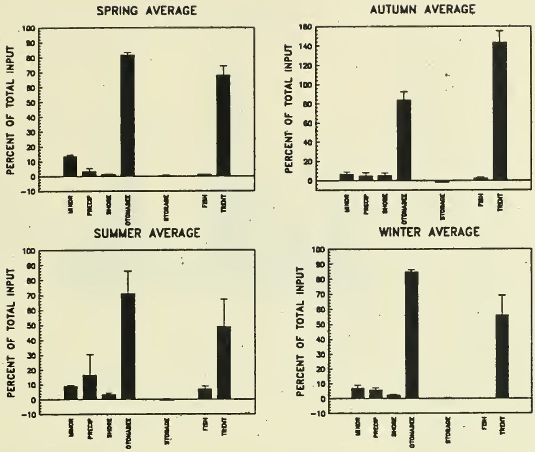
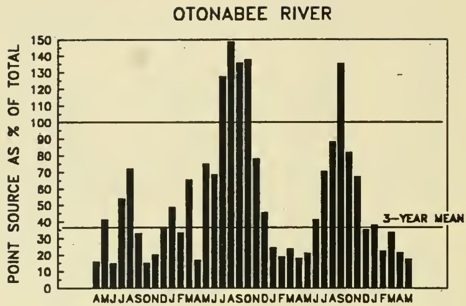


Figure14 : Seasonal average phosphorous loading from all inflows to Rice Lake as a percent of the total.

The Otonabee River was the major source of phosphorus to Rice Lake in all months, seasons and years(Figure 14, Table 17b). The load for the Otonabee River was calculated from measurements made at the river mouth. Two components of the Otonabee load were point sources in the lower watershed and the loads from the immediate and upstream watershed areas. The contribution of point sources to the total load could not be determined precisely because instream processes, such as sedimentation and uptake by wetland vegetation, varied between months and seasons. The annual budgets showed that 30-37.1% of the Otonabee River load was from point sources (Table 18), but monthly and seasonal point source contributions varied between approximately 15 and 150 percent of the total load (Figure 15). Values above 100% must be a result of instream processes removing phosphorus from the water column upstream of the mouth.



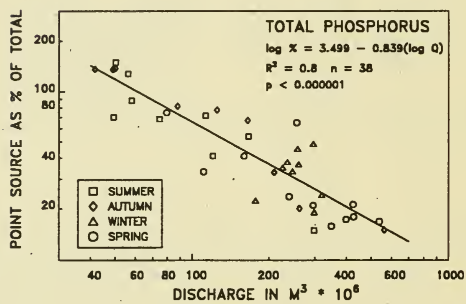


Figure 15: Monthly Otonabee River point source loadings as a percent of the total loading (top) and seasonally as a function of Discharge (bottom).

This explanation is supported by the observation (Figure 15) that calculated point source loadings only exceeded the measured loads at the mouth of the river during months of low flow. This suggests that significant amounts of TP were removed from the river during low flow and were not measured at the river's mouth. Maximum growth of aquatic or wetland macrophytes in the stream channel occurs during summer when flows are low, and low flow would allow particulate and algal-bound phosphorus to settle out between the source and the mouth. Point sources made up <30% of the total during high flow suggesting that TP was translocated from the sediments to the river mouth during these times.

Table 18: Summary of annual point source loadings of phosphorus to Rice Lake.

Otonabee River Point Sources (kg)

	1986–1987	1987–1988	1988–1989
Peterborough STP	18624	17633	15600
Peterborough WTP	85	87	83
Millbrook STP	89	82	98
Woodland Acres STP	166	168	125
Lakefield STP	108	48	100
Cresswood STP	18	18	18
Urban Runoff	1693	1693	1693
Total	20782	19727	17717
% of OT1 Load	30.0%	37.1%	34.1%

Ouse River Point Source (kg)

Norwood STP	128	87	106
% of OE1 Load	6.7%	4.3%	5.4%

Rice Lake: All Point Sources (kg)

Otonabee River	20782	19727	17717
Ouse River	128	87	106
Harwood Hatchery	151	151	151
Shoreline Develop.	1604	1604	1604
Total	22665	21570	19578
% of Total Loads to Rice Lake	28.2%	31.7%	30.5%

A model of the Otonabee River between Peterborough and Rice Lake was constructed to determine whether or not TP underwent a seasonal cycle of retention and release in this section of the river and whether or not any cycling influenced the total load of phosphorus measured at the river mouth. Loadings to the Otonabee River were broken into three components: the upstream load from sources above Peterborough, point sources within Peterborough, and incremental loads between Peterborough and the river mouth. Data from the Provincial Water Quality Monitoring Network (PWQMN) site at Nassau Mills above Peterborough was used to estimate upstream phosphorus supply. Point source loadings were taken from the present study. Loadings for the 686 km^2 area between Peterborough and the river mouth were prorated using the loadings estimated for the ungauged portion of the Rice Lake watershed in the present study.

Discharge of the Otonabee River at Nassau Mills was taken from records for the Auburn Generating Station provided by the Trent Severn Waterway (Hutchinson et al 1994a). Monthly discharge was multiplied by monthly measured concentration for the Nassau Mills site (LIS No. 17002401302) to estimate total monthly load. Point source loadings to the Otonabee River between Peterborough and the mouth were calculated as the sum of loadings from the WTP, STP and urban runoff in Peterborough plus loadings from the Millbrook and Crestwood sewage treatment facilities (this report). Incremental loadings from the 68600 ha of area between Peterborough & Rice lake were prorated using the ratio of this area to the total ungauged area of the Rice Lake watershed (24734 ha.). Figure 16 shows the contributions of each of the model components to the monthly loads

Modelled loads at the mouth of the Otonabee River were 64.9, 52.3 and 51.4 tonnes in each study year. Measured values for the same 3 years were 69.4, 53.2 and 52 tonnes. The model thus produced estimates of annual loads which were within 7% of the measured loads (Table 19).

Any retention or release of the upstream and point source loads of TP must have occurred in the wetlands and sediments between Peterborough and the mouth of the Otonabee River. Such processing could not influence the modelled estimates of load which were derived independently but would have influenced the measured load. Thus the difference between the measured load and the modelled load should reflect in-stream processing of TP. A negative difference (measured<calculated) suggests retention and a positive difference suggests release.

Modelled retention in the Otonabee River suggested that both biological and physical processes were important. Phosphorus was retained in the summer months of all three years and the autumn months of years 2 and 3 (Figure 16) suggesting biological uptake during the growing season. Summer retention also corresponded to the low flow periods of each year and autumn retention was noted in the two dry years of the study. These observations suggest the possibility of sedimentation of particulate phosphorus. Retention also occurred in the non growing season eg: Dec, 1986; Jan, Mar, Nov, Dec,1987; Dec, Nov,1988 and April 1989, (Figure 16) but these periods were typified by low flow. Thus low flow appeared to contribute to physical sedimentation in autumn and winter while both low flow and biological uptake may have contributed to summer retention.

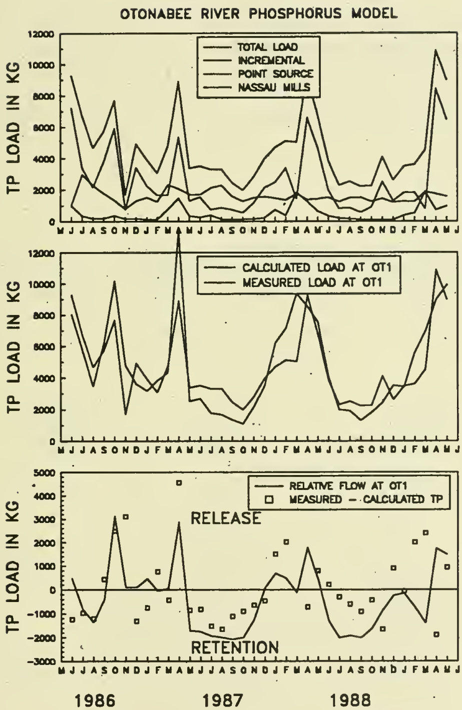


Figure 16 : Comparison of calculated and measured loads of total phosphorus to the Otonabee River between Peterborough and Rice Lake.

Release of phosphorus generally occurred when flow was either high or increasing (Figure 16) suggesting that physical translocation of particulate phosphorus was responsible for the release. Annual differences in modelled vs measured phosphorus were positive but small in all 3 years of the study (Table 19) which suggests that, on average, retention and release were balanced.

Retention of phosphorus in the Otonabee River was therefore significant on a seasonal basis but had no impact on the annual budget. In-stream retention of phosphorus during the summer suggests that the late summer increase in TP concentration in Rice Lake was due to in-lake processes rather than increased relative contributions from point sources. In summary, annual totals show that 32-40% of the Otonabee River load was from point sources. This appears to be a realistic total as instream retention and release balanced on an annual basis.

Table 19: Modelled and measured phosphorus loadings to the Otonabee River for the three year study period. All values are in tonnes unless noted otherwise.

	Modelled Totals		
	YEAR 1	**YEAR 2**	**YEAR 3**
Nassau Mills	38.97	26.44	28.32
Point Source	20.51	19.51	17.49
Ungauged	5.37	6.37	5.62
Total	64.85	52.33	51.43
Measured Total	69.38	53.16	51.99
Difference	4.53	0.83	0.56
% of measured	6.5	1.6	1.1

The small tributaries to Rice Lake (Bewdley North and South, ungauged areas and the Indian and Ouse Rivers) contributed minor loadings of phosphorus (Figure 14). Their combined contributions ranged from approximately 4-8% in autumn to 12-14% in spring (Table 20), and averaged 9.8 ± 1.7% over the entire study (Table 21).

Inputs from precipitation were significant in the summers of 1987 (30.7%) and 1988 (10%) and exceeded 5% of the total loading in all but 3 of the 12 seasons studied (Table 20). Precipitation loading included contributions from both dry deposition and precipitation events.

Shoreline development and the Harwood Fish Hatchery added 6% of the total load in autumn, 4% in summer and 2-3% in winter and spring. Changes in storage were trivial components of the Rice Lake phosphorus budget (<4% seasonally, Table 20). Fish harvest represented a significant loss of phosphorus from Rice Lake during the summer months. This observation is qualified, however, by the fact that the phosphorus in fish biomass accumulates over several years of growth and does not therefore represent a true component of a seasonal budget. These calculations also assume that no portion of the phosphorus from the fish returns to the Rice Lake watershed.

Table 20: Seasonal summary of percent contribution to the Rice lake phosphorus budget from all supply and loss terms

	1986-87				1987-88				1988-89			
Supply terms (% of total supply)	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr
Minor Tributaries	1.3	3.8	4.5	12.3	9.0	8.3	8.2	14.2	7.7	5.8	7.8	13.7
Otonabee R.	85.6	93.4	85.4	80.7	55.7	77.6	86.0	80.9	71.6	80.4	83.1	83.6
Precipitation	2.5	0.6	6.8	5.2	30.7	6.2	3.7	3.4	16.0	6.8	6.4	1.3
Shoreline loading	2.2	1.8	2.9	1.5	4.1	7.0	1.8	1.2	4.0	6.0	2.4	1.2
Harwood Hatchery	0.3	0.2	0.2	0.1	0.5	0.6	0.1	0.1	0.5	0.5	0.2	0.1
Loss Terms (% of Total loss)												
Fish Harvest	6.1	0.6	0	1.7	15.9	1.9	0	1.3	19.2	1.7	0	1.1
Trent River	93.9	99.4	100	98.3	84.1	98.1	100	98.7	80.8	98.3	100	98.9
Storage (% of supply)	-1.9	0.3	-0.3	0.6	0.4	-3.6	0	0.4	-0.3	-3.6	0.5	0

Table 21: Annual summary of percentage contribution to the Rice Lake phosphorus budget from all supply and loss terms

Supply Terms (%of total supply)	1986-87	1987-88	1988-89	All Years (mean+/- 1 SD)
Minor Tributaries & ungauged areas	7.9	11.1	10.4	9.8 ± 1.7
Otonabee River	86.2	78.0	81.0	81.8 ± 4.2
Precipitation	3.5	8.2	5.6	5.8 ± 2.3
Shoreline Development	2.0	2.4	2.5	2.3 ± 0.3
Harwood Hatchery	0.2	0.2	0.2	0.2 ± 0.02
Loss Terms (% of total loss)				
Fish Harvest	1.9	2.9	2.9	2.6 ± 0.8
Trent River	98.1	97.1	97.0	97.4 ± 0.6
Storage (% of supply)	-0.22	-0.08	-0.33	0.21 ± 0.13

The release of phosphorus from the sediments of Rice Lake was estimated as 8.2 tonnes per year (Beak 1988). Although apparently significant, this figure was not included in the budget calculations. The laboratory estimates were only 10-20% of those estimated for the Bay of Quinte by similar methods (Minns et al. 1986) and, in any event, the lake was shown to be a net sink for phosphorus except in autumn. Net retention of TP was therefore more important than release from sediments on an annual basis. Removing the sediment contribution from the budget allowed comparison of retention figures for Rice Lake with those from published studies of other lakes.

Point source contributions to the phosphorus budget were calculated as total load in kg and as percentage of the total. Point sources included the Peterborough STP, Peterborough WTP, shoreline development, urban runoff, the Harwood fish hatchery and small sewage treatment facilities at Millbrook, Norwood, Woodland Acres, Lakefield and Cresswood. Loadings from shoreline development and the Harwood fish hatchery were added directly to Rice Lake. The Norwood STP discharges to the Ouse River and so its contribution was measured as phosphorus supply from there. The remaining point sources discharged to the Otonabee River and were included in the measured load from the Otonabee River.

It is difficult to verify the importance of all point sources on the Otonabee River to the TP loading to Rice Lake. Phosphorus was assimilated or released between point source inputs in Peterborough and the mouth of the Otonabee River where input was measured. The relative point source contributions to Rice Lake varied seasonally (see previous discussion). All assessments of point source loading were thus made on the

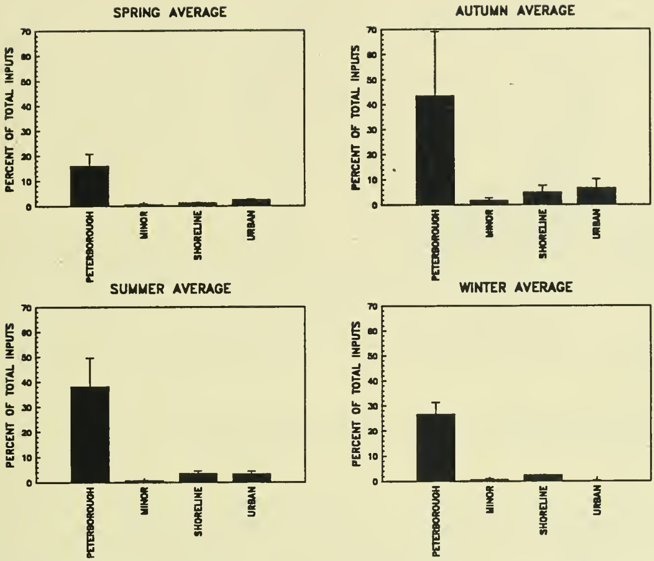


Figure 17: Seasonal phosphorus loads to Rice Lake from point sources as a percent of total inputs

premise that phosphorus sedimentation and resuspension in the Otonabee River balanced on an annual basis. The following discussion is therefore based on annual loads, with the assumption that all loadings to the river represent loadings to the lake.

Point sources added 20.8, 19.7 and 17.7 tonnes of phosphorus to the Otonabee River in each of the three study years. These loadings made up 30-37% of the TP in the Otonabee River and 28-32% of the total load to Rice Lake on an annual basis (Table 18). The Peterborough STP was the largest point source of phosphorus to Rice Lake. Loadings of 18.6, 17.6 and 15.6 tonnes in 1986-87, 1987-88 and 1988-89 respectively made up 27-33% of the TP in the Otonabee River, 89% of the point source load to the Otonabee River and 23-29% of the TP load to Rice Lake (Table 18). The loadings from the Peterborough STP were most important in the autumn, when they contributed 35 ± 27% of the TP load to Rice Lake. In the spring, these sources contributed 16 ± 5% of the total (Figure 17). Backwashing of filters at the Peterborough WTP was a minor source of phosphorus. Annual loads from this source were 83-87 kg or <0.6% of the loading from the STP.

Shoreline development on Rice Lake and urban runoff from Peterborough and Lakefield also made significant contributions of phosphorus to the budget. Each of these sources added approximately 1.7 tonnes annually (Table 18). Shoreline loadings were dominated by input from resorts (1.3 tonnes per year). Seasonal and permanent lakeside residences added an estimated 184 and 101 kg/yr, respectively (Appendix 3 A3-7). The seasonal contributions from shoreline development ranged from 1-7% and were slightly higher in summer and autumn (Table 20). Urban runoff was most important in the autumn (7% of total load, Figure 17, Appendix 3, Table A3-1 to A3-3)

Small sewage treatment facilities added 400-500 kg per year to the phosphorus load. The Millbrook and Norwood plants added 80-130 kg/ year; Woodland Acres added 125-170 kg/ year; Lakefield 47-108 kg/ year and Cresswood added 17.8 kg/ year. These loadings were insignificant in comparison to other point sources. They averaged <1% of the TP load to Rice Lake in all seasons but autumn (<2.5%, "minor", Figure 17) and <2.3% of total point source loading on an annual basis. The Harwood fish hatchery added 150 kg of phosphorus to Rice Lake each year (Table 18).

Annual phosphorus exports to Rice Lake from individual sources are given in Figures 18 and 19 and Table 22 as loads per unit area of source.

Table 22: Mean annual export of total phosphorus, chloride and potassium from streams in the Rice Lake watershed. Standard deviations of 3 years are in parentheses

	Total Phosphorus	**Chloride**	**Potassium**
	(mg/m² watershed area / yr)		
Bewdley North	13.3 (0.5)	1744 (175)	286 (24)
Bewdley South	35.0 (26)	1189 (48)	518 (171)
Indian River	7.6 (0.8)	2695 (191)	401 (26)
Ouse River	7.0 (0.2)	2486 (377)	272 (62)
Otonabee River	7.1 (1.2)	2919 (305)	368 (82)
Ungauged	8.4 (0.8)	2522 (157)	607 (36)
Precipitation[1]	39.9 (14.1)	193 (36)[4]	36 (8)[4]
Trent River	5.7 (1.5)	2604 (257)	341 (56)
Urban Runoff[2]	56 (0)		
Shoreline[3]	590 (0)		

1 (mg/m² lake surface area/yr, total dry + wet deposition)
2 (mg/ m² of urban area)
3 (mg/m² of shoreline lots)
4 (mg/m², wet deposition only)

Precipitation TP loadings averaged 39.9 ± 14.1 mg/m^2 of lake surface over the 3 year study. The average atmospheric loading for lakes in the Dorset area was 21.7 ± 7.6 mg/m^2 for the same period (Dillon et al 1992). Phosphorus export from the Otonabee River averaged 7.1 ± 1.2 mg/m^2/yr over the course of the study (Figure 18). This low figure is surprising in light of the large point source load from the Peterborough STP and is, in fact, lower than the load from the small tributaries and ungauged portion of the watershed (8.4 ± 0.75). The possible instream removal of phosphorus was discussed previously but large portions of the watershed load were undoubtedly removed by sedimentation in the upstream Kawartha lakes. In addition, dilute runoff from the Precambrian Shield into the upper portions of the Kawartha Lakes contributed to lower export figures. Urban runoff added 56 mg/m^2 of phosphorus per year from a total developed area of 3040 ha. Shoreline development had the highest export of 590 mg/m^2 of developed shoreline per year. Phosphorus retention in Rice Lake produced a total annual export of 5.7 ± 1.5 mg/m^2 of watershed at the Hastings outflow. Phosphorus export per m^2 of lake surface was 522 ± 136 mg/yr compared to a total areal load of 708 ± 85 mg/m^2. Fish harvest removed 13.5 mg/m^2/yr so net retention within the lake was 173 ± 55 mg/m^2 of lake area per year.

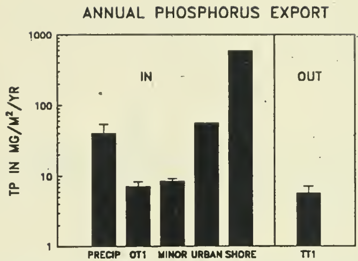


Figure18: Average annual phosphorus export for point sources to Rice Lake in mg/m^2/yr^1.

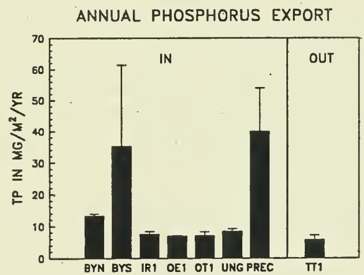


Figure 19: Average annual phosphorus export for inflows to Rice Lake in mg/m$^{2/}$yr^1.

There was little variation in phosphorus export among Rice Lake tributary streams. Loads from the larger streams averaged 7.4 ± 0.8 mg/yr/m^2 of watershed area (Table 22) but this figure may be low because of impoundments on the Indian and Ouse river where TP sedimentation would reduce the TP load. Export from Bewdley North was higher at 13.3 ± 0.5 mg/m^2/yr (Figure 19). The Bewdley South watershed was 93% agricultural and exhibited a flashy hydrologic response which produced the highest TP export figure (35 ± 26 mg/m^2/yr) in the Rice Lake watershed. Export from Bewdley South was consistently three to four times higher than from all other watersheds in winter and spring (Figure 20), but was intermediate in summer and autumn. This suggests that phosphorus export from this catchment was strongly associated with the hydrologic regime. Phosphorus loading to the lake surface from precipitation was highest in summer.

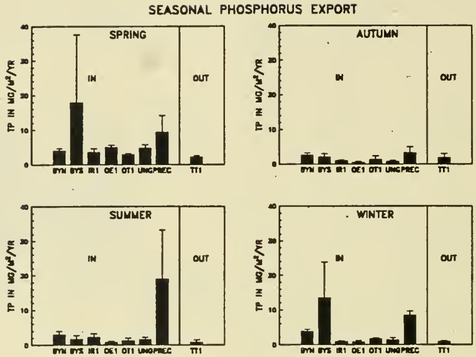


Figure 20: Average seasonal export of phosphorus to Rice Lake in mg/m^2/yr.

The 1986-1989 phosphorus budget for Rice Lake is summarized and compared to the 1975-76 budget in Table 23. The most notable comparison is in the apparent reduction of TP load from 123 tonnes in 1975-76 to 71 tonnes in 1986-89. There are several possible explanations for this. First, is the continuing effort to reduce phosphorus in sewage and detergents. The reduction from 141 to 123 tonnes from the Peterborough STP reflects implementation of an effluent limit of 1 mg/L TP between 1972 and 1975. Similar improvements at all sewage treatment facilities in the watershed would also contribute to the reduction. A second factor may be to improvements in phosphorus analyses techniques which were changed to a more sensitive method in 1981.

Table23: Comparison of Rice Lake phosphorus budgets for 1975-76 and 1986-89. All loadings are in metric tonnes per year. 1971-72 data are taken from MOE (1976). "Main Channel" loadings include the Otonabee, Indian and Ouse Rivers. "Land Drainage" is the ungauged portion of the watershed plus the two Bewdley streams, and"Local Loadings" are from shoreline development and the Harwood fish hatchery.

	Main Channel	Land Drainage	Precipitation	Local	Total	Outflow
1975-76	106[1]	12.5	2.2	1.9[4]	141(123[2])	76.7
1986-89	62.1[3]	2.9	4.0	1.8	70.9	53.6

1 Includes 37 tonnes from Peterborough STP
2 Lower value reflects phosphorus reductions in 1975-76.
3 Includes 17.3 tonnes from Peterborough STP
4 Does not include Harwood Fish Hatchery

Main channel loadings were reduced from 106 to 62 tonnes between 1976 and 1986-89. The 1976 load calculations were based on biweekly measurements and linear interpolation of daily concentrations. In the present study, phosphorus in the Otonabee Ouse and Indian Rivers was measured at least weekly with daily measurements during high flow periods. This improved the resolution of changes in phosphorus concentration and produced a more accurate estimate of total load.

Land drainage loadings decreased from 12.5 tonnes in 1976 to 2.9 tonnes in 1986-89. The 1976 estimates were based on pro-rated loading data from the Ouse River and Nogies Creek. In the present study, local loadings were determined from measurements on the Indian and Ouse Rivers and the two Bewdley Creeks. The present estimate is therefore more likely to be a valid estimate of local conditions.

Precipitation loading apparently doubled between the two studies. The 1976 study cites TP concentrations of 21 & 60 ug/L in rain and snow respectively (p119, OMOE/MNR 1976), compared to 15 ug/L measured in "wet" precipitation in the present study. The 1976 study did not measure dry TP deposition. The ratio of total wet deposition of phosphorus was 3.7:1 in the present study and so the doubling in precipitation load reflects ; a) measurement of "total" P (wet + dry = four fold increase) and b) lower TP in wet precipitation (reduces to two fold). Local (ie: point source) loadings showed no change between the two studies. The 1976 study estimated shoreline loadings on the basis of 80% retention of a per-capita load of 1.3 kg/yr and did not include the Harwood Fish Hatchery which did not exist at that time. The present study used a per-capita loading figure of 0.8 kg/yr and assumed some retention of phosphorus. The implications of the asssumptions regarding retention will be discussed in the summary report (Hutchinson et al 1994d).

In summary the only portion of the decrease in phosphorus load to Rice Lake between 1976 and 1986-89 which appears to be valid is an 18 tonne reduction in phosphorus load at the Peterborough STP plus smaller reductions at other facilities. The remaining changes may be an artifact of the different methods used to estimate the load.

Rice Lake: Chloride Budget

The chloride budget for Rice Lake was calculated as a check on the accuracy of the phosphorus budget. Chloride, a conservative ion, will not be taken up by vegetation, lost to lake sediments or modified by other watershed processes. Data were not available to convert wet only precipitation loading of chloride to total deposition as was done for TP. This was not a significant factor in the budget however and so any differences were ignored.

Initial estimates produced a chloride budget which balanced (output/input - storage) to within 91%, 93% and 90% in 1986-87, 1987-88 and 1988-89 respectively. When corrected for flow by balancing the hydrologic budget the balances improved to 99%, 96% and 94% (mean = 97.6% ± 7.3%, Table 24).

The accuracy of the chloride balance verifies that the mass balance methodology was sound, and that all relevant sources and losses of chloride to Rice Lake were considered. It is therefore valid to conclude that the phosphorus budget was sound and that differences between losses and supply were due to sedimentation and retention of phosphorus within Rice Lake.

Table 24: Annual and seasonal balances of the chloride budget for Rice Lake in 1986-87, 9187-88, 1988-89. All balances are presented as percentages (output/input-storage) following correction for water balance.

	Summer	Autumn	Winter	Spring	Annual
1986-1987	102.4	102.4	103.6	92.6	99.2
1987-1988	92.4	107.0	91.5	99.3	96.1
1988-1989	86.3	109.1	90.5	94.4	94.2
Mean	93.7	106.3	95.2	95.4	97.6
(S.D.)	(8.1)	(3.4)	(7.3)	(3.5)	(7.3)

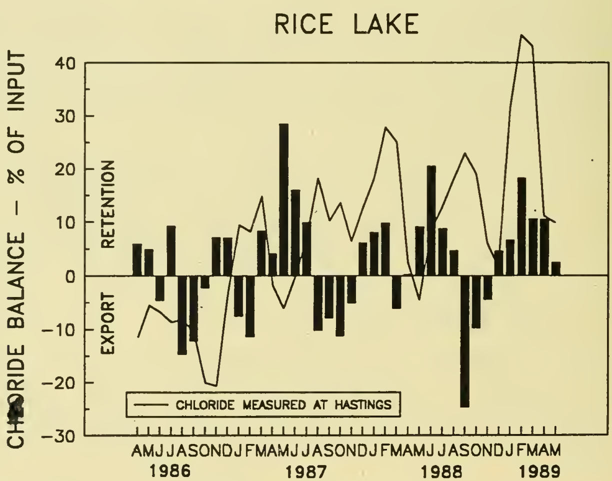


Figure 21: Monthly chloride balance for Rice Lake for 1986-87,1987-88,1988-89.

Seasonal balances of chloride ranged from 93.7 - 95.4% for all seasons but autumn. In autumn, Rice Lake exported 106% of all chloride inputs, after correction for a net export of water (Table 24). Chloride export was highest in the autumns of 1987 and 1988 (Table 24) and the hydrologic balances of 117 and 120% exceed the average autumn balance of 112%. Autumn chloride concentrations were also higher than average and so it was exported from the lake (Fig 21). Monthly chloride balances ranged from 72% (retention = 28%) in May of 1987 to 125% (export = 25%) in September of 1988. Rice Lake tended to export chloride in some winter months as well as in autumn, (Figure 21) compared to phosphorus, which showed a net export in autumn only. The overall balance of the chloride budget suggests, however, that variations in export between seasons merely reflected hydrologic flushing of the lake and its watershed.

Total chloride supply to Rice Lake ranged from 24,607 tonnes in 1988-89 to 29,184 tonnes in 1986-87. (Table 25) The high supply term in 1986-87 reflected the high water supply that year. Water yield was 44% in year 1 compared to 32-35% in the final two years.

The chloride supply to Rice Lake was dominated by the Otonabee River in all seasons (Table 26). Its contribution ranged from 89 ± 4.5% in summer to 94.1 ± .52% in winter. The combined total from shoreline loading and precipitation was less than 1% and the minor tributaries contributed 6-10%.

Point sources, including shoreline development added 1911-1920 tonnes of chloride to Rice Lake each year, or 6.5 - 7.6% of the total load, mostly from the Peterborough STP (1803 tonnes/year, Table 27). By comparison, point sources made up 25-28% of the annual phosphorus load to Rice Lake and the Peterborough STP accounted for 80% of that total (Table 18). The STP was thus a far more important source of phosphorus to Rice Lake than of chloride. Chloride from the STP made up 21-35% of total chloride in the Otonabee River during the dry summers of 1987 and 1988 (Appendix 3.18) when low discharges reduced the contributions from other sources in the watershed. Other point sources made trivial contributions to the Rice Lake chloride budget .

Table 25: Annual balance of the Rice Lake chloride budget for 1986-87, 1987-88, 1988-89. All values in tonnes unless otherwise noted.

Supply terms

	1986-1987	1987-1988	1988-1989
Bewdley North	10.0	10.8	12.2
Bewdley South	27.0	25.2	27.0
Ouse River	793.0	726.0	585.0
Indian River	704.0	642.0	739.0
Otonabee River	26910.0	22560.0	22570.0
Ungauged	667.0	611.0	593.0
Precipitation	15.2	21.3	21.5
Shoreline	57.3	42.2	59.4
TOTAL	29184.0	24638.0	24607.0

Loss terms

	1986-1987	1987-1988	1988-1989
Trent River	26480	22830	22090
TOTAL	26480	22830	22090

	1986-1987	1987-1988	1988-1989
Storage	-45.9	11.3	80.4
Balance (kg) (Out-In+Storage)	-2750	-1797	-2437
Balance (%) (Out/In-Storage)	91%	93%	90%

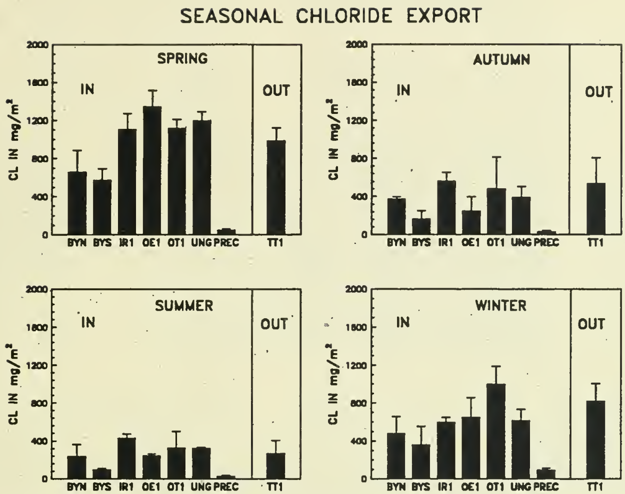


Figure 22: Average seasonal export of chloride from inflows to Rice Lake in mg/m^2 of watershed/year

The seasonality of chloride export from Rice Lake streams (Figure 22) reflected seasonal water yield. Export figures (mg.m^{-2}) decreased in the order of water yield; from spring to winter to autumn to summer. Chloride export per unit of watershed area was lowest for the Bewdley South stream (Table 22) but its phosphorus export was very high, by comparison (Fig. 19). If watershed geochemistry had been the only factor determining export, Bewdley South should have shown the same ranking for phosphorus as for chloride. The high phosphorus export, compared to chloride, may reflect the fact that 92% of the Bewdley South watershed was used for agriculture such that fertilizer, erosion and cattle wastes enriched the TP content of runoff. Chloride export from the Otonabee River was highest in the winter. Road salt applications in the urban portions of the watershed, particularly in Peterborough, may have been contributed to this.

Table 26: Seasonal chloride balance for Rice Lake for 1986–87, 1987–88, 1988–89. All values in tonnes unless noted

Supply terms

	1986–1987				1987–1988				1988–1989			
	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr
Bewdley North	2.40	2.18	2.00	3.41	0.96	2.38	4.24	3.25	1.06	2.51	2.83	5.79
Bewdley South	2.46	5.80	5.05	13.70	2.00	2.62	5.76	14.77	1.78	2.51	12.99	9.72
Ouse River	74.0	118.9	165.9	434.2	68.5	47.2	248.8	361.4	64.1	43.7	134.3	342.6
Indian River	101.4	169.7	153.0	280.2	108.5	122.3	168.0	243.5	123.8	142.5	142.3	330.7
Otonabee River	4308	7102	6960	8543	1595	2018	9981	8965	2138	2745	7620	10070
Ungauged	78.4	129.0	141.8	318.2	78.3	75.9	185.6	271.0	82.9	83.2	127.2	299.6
Precipitation	3.82	0.99	7.15	3.23	2.46	4.07	10.37	4.45	1.41	3.37	10.32	6.39
Shoreline	19.7	26.4	1.1	10.1	22.0	10.4	1.1	8.7	14.2	13.3	1.4	30.5
TOTAL	4591	7555	7436	9606	1878	2283	10605	9872	2427	3036	8051	11095

Loss terms

	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr
Trent River	3894	7713	6973	7903	1782	2924	9393	8728	1589	4086	6071	10340
TOTAL	3894	7713	6973	7903	1782	2924	9393	8728	1589	4086	6071	10340
Storage	-111.3	-8.3	-18.0	91.8	-0.7	-57.9	1.4	68.6	-17.0	-82.0	64.0	115.4
Balance (kg) (Out–In+Storage)	-808	150	-481	-1612	-97	583	-1210	-1076	-855	967	-1916	-640
Balance (%) (Out/In–Storage)	83	102	94	83	95	125	89	89	65	131	76	94

Table 27: Annual summary of point source chloride budgets for Rice Lake.

Otonabee River Point Sources (kg)

	1986–1987	1987–1988	1988–1989
Peterborough STP	1803410	1803410	1803410
Peterborough WTP	2828	2910	2863
Millbrook STP	2808	2808	2808
Woodland Acres STP	3816	3816	3816
Lakefield STP	28717	28717	28717
Cresswood STP	1586	7546	1880
Total	1843166	1849207	1843494
% of OT1 Load	6.8%	8.2%	8.2%

Ouse River Point Source (kg)

Norwood STP	17002	20222	17673
% of OE1 Load	2.1%	2.8%	3.0%

Rice Lake: All Point Sources (kg)

Otonabee River	1843166	1849207	1843494
Ouse River	17002	20222	17673
Shoreline Develop.	57276	42238	59446
Total	1917444	1911667	1920613
% of Rice Lake Total Loading	6.5%	7.6%	7.6%

Rice Lake: Potassium Budget

Potassium concentrations in Rice Lake cycled in response to hydrology and the growth and senescence of the aquatic macrophyte community. A potassium budget was constructed to illustrate the dynamics of potassium in Rice Lake, and to aid in interpretation of the intensive study of growth and senescence of *Potamogeton crispus* in 1987. Detailed discussion of the linkage between nutrients and macrophytes will be presented in the summary report (Hutchinson et al 1994d).

Initial estimates produced balances (output/input - storage) of 90%, 91% and 103% in 1986-87, 1987-88 and 1988-89 respectively. Balancing the hydrology budget adjusted these figures to 99, 94 and 108% (Table 29). Supplies exceeded or were within 3% of losses in winter and spring of all years, in autumn of 1986 and in the summers of 1987 and 1988. Loss exceeded supply (net export, balance >100%) in autumn of all years and in the summer of 1986.

Table 28: Annual and seasonal balances of the potassium budget for Rice Lake in 1986-87, 1987-88, 1988-89. All balances are presented as percentages (output/input-storage) following correction for water balance.

	Summer	Autumn	Winter	Spring	Annual
1986-1987	119.2	102.3	97.2	89.1	99.1
1987-1988	89.5	123.9	98.2	85.1	94.4
1988-1989	94.6	141.3	102.5	102.6	107.6
Mean (S.D.)	101.1 (15.9)	122.5 (19.5)	99.3 (2.8)	92.3 (9.2)	103.8 (16.5)

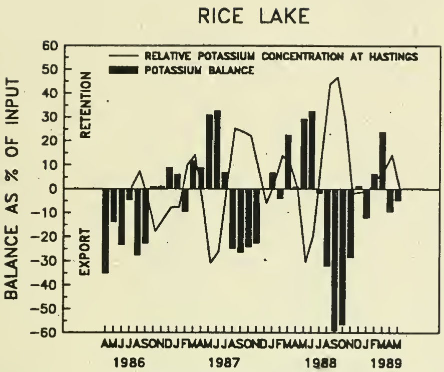


Figure 23: Monthly potassium budget for Rice Lake expressed as a percent of input

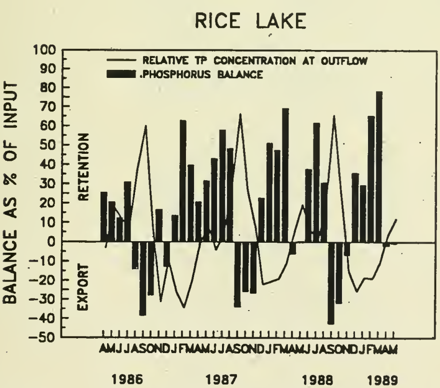


Figure 24: Monthly phosphorus budget for Rice Lake expressed as a percent of input

These seasonal dynamics reflected the growth and senescence of the aquatic macrophyte community well. Growth of macrophytes produced low concentrations of potassium in the lake outflow at Hastings and net retention in the lake during late spring and early summer. Dieback in late summer and the autumn was clearly observed as a rise in potassium concentrations at the outflow and net export from the lake (Figure 23). The phosphorus cycle also showed a clear link between increased concentrations at Hastings and net export (Figure 24). The autumn export occured at the same time as peak outflow concentrations and outflow concentrations declined over the export period. The phosphorus cycle appeared, however, to lag 1 month behind the potassium cycle. Rice Lake also exported potassium in the first summer of the study. Higher water yield in that year produced a larger mass of potassium for plant growth, and moved it through Rice Lake more quickly. Potassium was present in surplus quantities and so was exported. Table 30 shows that total potassium supply was 4101 tonnes in 1986-87, 1.4 times greater than in the other two years. Water supply was 1.5 times greater and water yield was 44% in year one, compared to 32-35% in the final two years.

Table 29: Annual potassium balance for Rice Lake for 1986-87, 1987-88, 1988-89. All values in tonnes unless noted.

Supply terms

	1986-1987	1987-1988	1988-1989
Bewdley North	1.6	1.9	1.9
Bewdley South	7.1	14.1	13.3
Ouse River	92.6	79.4	57.9
Indian River	110.9	97.8	101.9
Otonabee River	3785	2814	2491
Ungauged	92	84	76
Precipitation	4.4	3.7	2.7
Shoreline	7.9	5.2	6.6
TOTAL	4101	3100	2752

Loss terms

Trent River	3707	2821	2828
TOTAL	3707	2821	2828

Storage	3.6	3.4	1.5
Balance (kg) (Out-In+Storage)	-398	-282	75
Balance (%) (Out/In-Storage)	90%	91%	103%

Table 30: Seasonal potassium balance for Rice Lake for 1986–87, 1987–88, 1988–89. All values in tonnes unless noted.

Supply terms

	1986–1987				1987–1988				1988–1989			
	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr
Bewdley North	0.4	0.5	0.3	0.5	0.2	0.4	0.6	0.6	0.2	0.4	0.6	0.7
Bewdley South	0.8	1.4	1.1	3.8	0.7	1.1	3.4	8.9	0.7	0.8	8.0	3.9
Ouse River	7.0	14.9	14.6	56.0	5.2	4.7	22.4	47.2	5.7	3.4	11.7	37.2
Indian River	16.0	29.4	19.9	45.7	16.5	16.8	23.6	40.9	17.4	16.6	13.8	54.1
Otonabee River	574	1057	981	1174	213	245	1110	1247	266	299	721	1206
Ungauged	10.5	20.1	15.7	46.1	9.8	10.0	21.8	42.4	10.4	9.2	14.8	41.7
Precipitation	2.0	1.4	0.6	0.4	1.7	0.9	0.2	0.9	1.3	0.4	0.4	0.5
Shoreline	2.7	4.2	0.1	0.8	2.8	1.7	0.1	0.7	1.9	2.1	0.2	2.4
TOTAL	613	1128	1033	1327	249	280	1182	1389	304	332	770	1347

Loss terms

	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr
Trent River	597	1151	908	1051	228	418	1123	1052	217	583	657	1371
TOTAL	597	1151	908	1051	228	418	1123	1052	217	583	657	1371
Storage	-6.2	-1.1	-1.7	12.6	1.6	-8.6	0.2	10.1	-0.7	-12.1	7.0	7.3
Balance (Out–In+Storage)	-22.4	21.5	-127.0	-263.0	-20.1	-129.0	-58.2	-326.3	-87.4	-239.2	-106.0	-32.0
Balance (%) (Out/In–Storage)	96%	102%	88%	80%	92%	145%	95%	76%	71%	170%	86%	102%

Potassium supply to Rice Lake was dominated by the Otonabee River in all seasons (Table 31,Figure 25) Although absolute supply to the lake ranged from 249 tonnes in the summer of 1987 to 1389 tonnes in the spring of 1988, the seasonal contribution from the Otonabee River was relatively constant, at 85-95% of the total. Point sources of potassium, as for chloride, were minor components of the load to the Otonabee River (Table 32) and Rice Lake. They added 10-16% of the Otonabee River potassium load in the summer and autumn of 1987 and 1988 but <6% in all other seasons. Point sources added 24-25% of the potassium supply to Rice Lake in the dry autumn of 1988 (Appendix 3.11) and most of that was included in the Otonabee River measurements. The smaller streams and rivers and ungauged portion of the watershed added 7.4 - 9.1% of the potassium to Rice Lake yearly. Precipitation and shoreline loading were trivial components of the supply. They added <0.3% to the total.

The Bewdley South stream had the highest variation in potassium export between seasons and years; a function of its flashy and variable hydrologic regime. Potassium export ranged from 247 ± 131 mg/m^2 of watershed in spring to 32 ± 3.8 in summer. (Figure 25) The Bewdley North stream and the Indian River had the narrowest range in potassium export values. Export from Rice Lake through the Trent River at Hastings was intermediate to that in all other streams in winter and summer. Growth of macrophytes in the spring reduced potassium export to the second lowest of all streams (Table 33, Figure 25) and their senescence in autumn produced export figures which were higher than all streams but the Indian River.

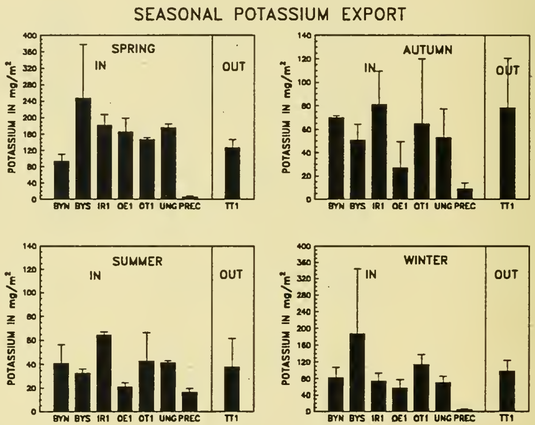


Figure 25: Average seasonal export of potassium from inflows to Rice Lake in mg/ m^2 of watershed/yr.

In conclusion, comparison of the potassium and phosphorus budgets for Rice Lake with the chloride budget illustrates the clear role of the aquatic macrophyte community in regulating the cycling of plant nutrients.

Table 31: Annual summary of point source potassium budgets for Rice Lake. All values in tonnes unless noted.

Otonabee River Point Sources

	1986–1987	1987–1988	1988–1989
Peterborough STP	161	161	161
Peterborough WTP	0.04	0.05	0.04
Millbrook STP	2.54	2.54	2.54
Woodland Acres STP	0.44	0.44	0.44
Lakefield STP	3.89	3.89	3.89
Cresswood STP	0.21	0.79	0.20
Total	169	169	169
% of OT1 Load	4.5%	6.0%	6.8%

Ouse River Point Source

Norwood STP	1.78	1.80	1.81
% of OE1 Load	1.9%	2.3%	3.1%

Rice Lake: All Point Sources

Otonabee River	169	169	169
Ouse River	1.78	1.80	1.81
Shoreline Develop.	7.87	5.23	6.61
Total	178	176	177
% of Rice Lake Total Loading	4.3%	5.7%	6.4%

Sturgeon Lake: Hydrology Budget

A detailed presentation of the Sturgeon Lake hydrology budget was given in the hydrology volume of the Rice - Sturgeon Lake series (Hutchinson et. al. 1994a). Key findings necessary to relate the hydrology and nutrient budgets are presented here.

Overall balance of the Sturgeon Lake hydrology budget was positive in the first study year and negative in the second and third years when expressed as:
Output - (Input + Storage).
Loss terms exceeded supply terms by 6.4% in 1986-87. Supply terms exceeded loss terms by 1.1% and 6.3% in 1987-88 and 1988-89 respectively. (Table 32, Figure 26). On average, supply terms exceeded loss terms in the spring of all years and were less than loss terms in the summer. The relative balances for autumn and winter differed between the three study years (Table 33, Figure 27).

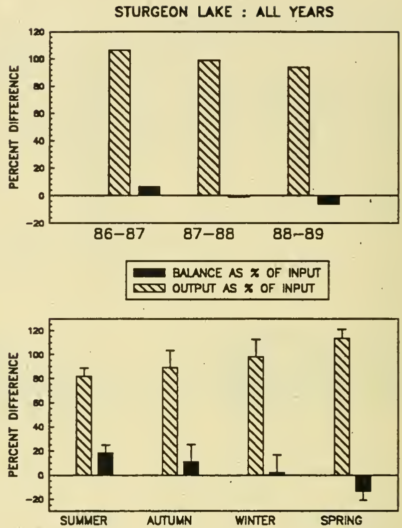


Figure 26: Annual and seasonal hydrology budget balance for Sturgeon Lake.

Supply terms were dominated by the major inflow at Fenelon Falls which provided 73 ± 8%, 75 ± 3%, 76 ± 4% and 87 ± 4% of the total inflow in spring, winter, autumn and summer respectively (Figure 27). The Scugog River supplied 6-15% of the total flow in each season and its contribution was highest in the autumn. The smaller streams and ungauged portions of the watershed supplied 3-14% of the total inflow in each season and were most important in the spring. Precipitation accounted for <4% of the supply in all seasons. Evaporation was only a significant loss term in the summer when it accounted for 10% of the loss.

The hydrology balance was poorest in October of 1988 (68.6%) and March of 1987 (127.6%). Seasonal balances were poorest in the summer of 1988 (74.6%) and the spring of 1987 (122.1%, Table 33). Annual hydrology balances were adjusted so that total loss equalled total supply in order to adjust the elemental and nutrient budgets for flow. Total outflows were multiplied by 0.939, 1.011 and 1.067 for 1986-87, 1987-88 and 1988-89 respectively.

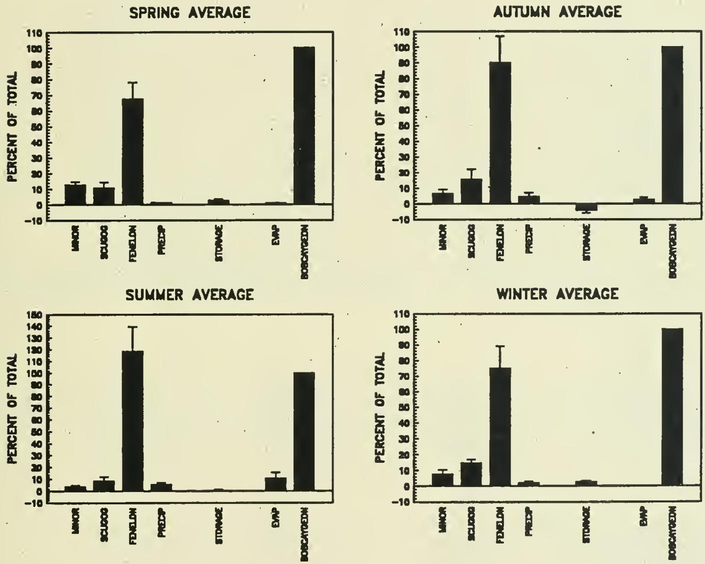


Figure 27: Seasonal hydrology budget for Sturgeon Lake sources expressed as a percent of the total outflow.

Table 32: Annual balance of the Sturgeon Lake hydrology budget for 1986-87, 1987-88 and 1988-89. All values are $m^3 \times 10^6$ except where noted.

Supply Terms	**1986-87**	**1987-88**	**1988-89**
Martin Creek	17.08	8.8	12.21
Hawkers Creek	23.06	13.31	16.3
Rutherford Creek	3.78	2.5	2.44
Dunsford Creek	9.99	5.26	9.09
Emily at Downeyville	5.56	8.14	4.57
Emily Creek	49.84	42.93	43.75
McLaren Creek	24.92	14.03	12.6
Scugog River	293.9	205.4	132.6
Fenelon Falls	1501.0	1256.0	1261.0
Ungauged Area	79.2	48.83	53.68
Precipitation	39.56	39.47	39.7
Total*	**2032.34**	**1631.27**	**1574.28**

*Total does not include Dunsford Creek or Emily at Downeyville which are included in the Emily Creek total.

Loss Terms			
Big Bob Channel	2135.0	1579.0	1439.0
Evaporation	28.64	35.02	36.44
Total	**2163.64**	**1614.02**	**1475.44**
Storage	-0.471	-0.942	0
Balance (Out-In+Storage)	130.8	-18.2	-98.8
% (Out/In-Storage)	106.4	98.9	93.7
Adjustment for 100% balance	**0.939**	**1.011**	**1.067**

Table 33. Seasonal balance of the Sturgeon Lake hydrology budget for 1986–1987, 1987–1989 and 1988–1989.

Supply terms (m3 x 10E6)

	1986–1987				1987–1988				1988–1989			
	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr
Martin	1.46	6.25	2.08	7.27	0.73	0.74	2.47	4.86	0.65	1.64	2.28	7.63
Hawkers	1.68	8.91	3.72	8.74	0.79	1.05	4.25	7.22	0.33	1.51	2.64	11.82
Rutherford	0.50	1.32	0.45	1.51	0.01	0.11	0.84	1.54	0.19	0.18	0.33	1.74
Dunsford	1.05	2.72	0.72	5.50	0.05	0.06	1.21	3.93	0.09	0.58	0.72	7.70
Emily at Downeyville	0.49	1.35	0.22	3.50	0.15	0.49	2.65	4.85	0.17	0.26	0.53	3.61
Emily	4.92	13.03	3.04	28.84	0.65	1.78	12.36	28.14	0.84	2.67	3.99	36.24
McLaren	2.69	8.12	3.02	11.09	0.11	0.65	6.06	7.21	0.14	2.30	3.36	6.53
Scugog River	39.87	98.08	62.78	93.19	16.92	42.48	89.87	56.15	6.15	24.86	32.42	69.19
Fenelon Falls	360.3	517.3	279.5	344.7	198.1	176.0	356.7	525.1	218.9	246.0	235.0	560.6
Ungauged	7.39	25.80	9.53	33.28	2.06	2.69	14.12	25.73	1.82	9.11	13.56	36.63
Precipitation	13.90	12.07	6.53	7.06	11.18	11.61	8.96	7.72	9.37	13.69	8.25	8.38
TOTAL *	432.7	690.8	370.6	535.6	230.5	237.1	495.6	663.6	238.3	301.9	301.8	738.7

*Total does not include Dunsford Creek or Emily at Downeyville.

Loss terms

Big Bob Channel	366.3	723.2	423.9	621.4	171.3	185.3	528.0	694.6	155.4	236.5	257.2	790.0
Evaporation	17.87	6.37	0.00	4.39	20.86	7.27	0.00	6.88	22.74	7.35	0.00	6.35
TOTAL	384.2	729.6	423.9	625.8	192.2	192.6	528.0	701.5	178.1	243.8	257.2	796.4

Storage	–3.3	–1.4	–18.8	23.1	–1.9	0.5	–14.6	15.1	–0.5	–2.8	–14.6	17.9

Balance	–51.8	37.3	34.4	113.2	–40.3	–44.1	17.8	52.9	–60.7	–60.9	–59.2	75.5
% of Loss	88.1	105.4	108.8	122.1	82.7	81.4	103.5	108.2	74.6	80.0	81.3	110.5

Sturgeon Lake: Phosphorus Budget

The total supply of phosphorus to Sturgeon Lake from all sources was 32.5, 27.1, and 28.6 tonnes in 1986-87, 1987-88, 1988-89 (Table 34, Figure 28). Total measured losses at the Bobcaygeon outflow were 29.6, 18.3 and 19.8 tonnes for the same periods. The annual balances of the Sturgeon Lake phosphorus budget were 91%, 67% and 69% when losses were expressed as a percentage of all inputs and adjusted for storage terms (Table 34).

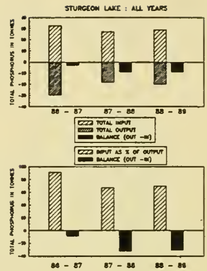


Figure 28 : Annual phosphorus budget balance for Sturgeon Lake.,

The annual phosphorus budgets were adjusted for errors in the hydrologic balance by multiplying them by 0.939, 1.011 and 1.067; the factors used to adjust flow so that total losses equalled total supply (Table 35). The resulting figures showed that 86%, 68% and 74% of the TP supply to Sturgeon Lake was exported downstream from Bobcaygeon. In-lake retention (100-adjusted export) was therefore 14%, 32% and 26% (ave=24%) in each study year. Low retention in 1986-87 was the result of higher water supply and yield. Yields (runoff/precipitation) were 53%, 40%, and 36% in each of the study years (Table 35).

Phosphorus loads to Sturgeon Lake were highest in the three spring months, averaging 11.5± 1.6 tonnes over the course of the study. Autumn loads averaged 6.9± 3.1 tonnes, summer loads 5.6±1.4 tonnes and winter loads 5.4±0.9 tonnes (Table 36). Phosphorus loading per unit of flow was highest in summer and lowest in winter (Figure 29). Although part of this summer loading could be attributed to seasonal use of shoreline residences, regressions showed that the relationship between water and phosphorous loads was strongest in the summer ($p<0.002$, $r^2=0.87$; Table 36) suggesting that other sources in the watershed were important. Further evidence of high summer loading is given by the slope of the line relating phosphorus load to water load which was 25% greater in summer than in autumn and winter (Table 36). Winter and spring phosphorus loadings were significantly but weakly related to water loads (Figure 29, Table 36), which may reflect the high loading of low phosphorus water from the largely Precambrian watershed of Sturgeon Lake .

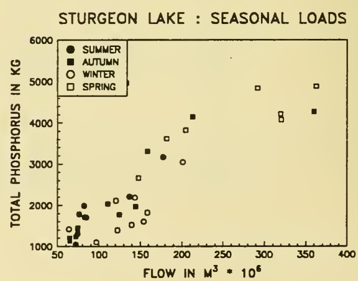


Figure 29: The seasonal relationships between phosphorus and water loads for Sturgeon Lake.

Table 34: Annual balance of the Sturgeon Lake phosphorus budget
Sediment loadings were not included in totals or in balance figures.
All values in tonnes unless noted.

Supply terms

	1986–1987	1987–1988	1988–1989
Fenelon Falls	13.99	10.02	10.60
Emily	1.04	0.96	1.45
Hawkers	0.31	0.28	0.32
McLaren	0.49	0.45	0.24
Martin	0.32	0.28	0.32
Rutherford	0.07	0.08	0.07
Scugog River	8.98	6.36	6.59
Lindsay STP	3.04	3.25	4.17
Lindsay WTP	0.02	0.02	0.02
Fenelon Falls STP	0.21	0.16	0.16
Springdale Gdns STP	0.05	0.05	0.05
Ungauged	1.53	1.33	1.27
Precipitation	1.32	2.77	2.28
Shoreline	0.66	0.66	0.66
Sediments	3.82	3.82	3.82
Urban Runoff	0.44	0.44	0.44
TOTAL	32.45	27.09	28.61

Loss terms

	1986–1987	1987–1988	1988–1989
Big Bob Channel	29.44	18.16	19.72
Fish Harvest	0.11	0.11	0.11
TOTAL	29.55	18.28	19.83

	1986–1987	1987–1988	1988–1989
Storage	0.14	0.00	-0.06
Balance (Out-In+Storage)	-2.76	-8.82	-8.84
Balance (%) (Out/In-Storage)	91%	67%	69%

Table 35: Calculation of net annual and seasonal phosphorus retention in Sturgeon Lake for 1986-87, 1987-88, 1988-89. Sediment loadings were not included in totals or in balance figures.

	% Hydrology Balance (uncorr)	Correction Factor (100/Bal)	% Phosphorus Balance (uncorr)	(corr)	% Phosphorus Retention (100-corr.bal.)	Water Yield (Runoff/Precip)
1986-87	106.4	0.94	91.5	86.0	14.0	53.4%
1987-88	98.9	1.011	67.5	68.2	31.8	39.6%
1988-89	93.7	1.067	69.2	73.8	26.2	35.8%
Summer	81.8	1.222	67.5	81.8	18.2	17.5
Autumn	88.9	1.125	70.5	77.7	22.3	29.5
Winter	97.8	1.022	62.1	62.4	37.6	49.2
Spring	113.6	0.880	86.2	75.8	24.2	84.2

Table 36: Relationship of phosphorus and water loads for Sturgeon Lake, 1986-89. Total loading figures are average values from all sources over the 3 year study. Regressions were calculated using monthly loadings grouped for each season.

	Phosphorus Load (Tonnes)	**Water Load** ($m^3 \times 10^6$)	**Equation**	**r2**	**P**
Summer	5.6 ± 1.4	301 ± 115	Load=14.1(flow)+427	0.87	<0.002
Autumn	6.9 ± 3.1	410 ± 245	Load=11.9(flow)+641	0.82	<0.0008
Winter	5.4 ± 0.9	389 ± 98	Load=11.1(flow)+328	0.55	<0.02
Spring	11.5 ± 1.6	646 ± 103	Load=7.8(flow)+2081	0.67	<0.05

Sturgeon Lake, unlike Rice Lake, retained phosphorus in all seasons (Figure 30, Table 37). Average annual phosphorus retention was 24% of the phosphorus supply and varied from 38% in winter to 18% in summer. It is unclear why Rice Lake exported phosphorus in autumn while Sturgeon Lake did not. Hydraulic residence times were similar in the two lakes differing by less than one day on an annual basis. The residence time of Sturgeon Lake in autumn averaged 53 ± 29 days over the course of the study compared to 46 ± 24 days in Rice Lake. Longer autumn residence times would increase retention in Sturgeon Lake and may have accounted for part of the difference. The net export of phosphorus from Rice Lake in autumn may have been related to senescence of the summer macrophyte or algal communities. No estimates of macrophyte biomass were available in Sturgeon Lake but Rice Lake is known to have higher macrophyte biomass than most other Kawartha Lakes (MOE/MNR 1976) and the greater mean depth than Sturgeon Lake (3.5 vs 2.4 m) would limit the amount of macrophyte coverage and increase retention overall. It is also not clear why retention in Sturgeon Lake was highest in the winter.

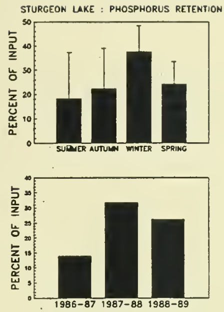


Figure 30: Seasonal and annual phosphorus retention for Sturgeon Lake.

Differences in the seasonal cycles of phosphorus concentrations and water balance may also have influenced phosphorus export from Rice and Sturgeon Lakes. Autumn export from Rice Lake was partly related to a positive hydrologic balance in autumn, so that phosphorus to some extent was exported with the water. Sturgeon Lake, by contrast had a negative hydrologic balance in autumn and so water and hence phosphorus was retained (Table 35). Finally, autumn phosphorus concentrations at the Bobcaygeon outflow from Sturgeon Lake averaged 10-30 ug o L^{-1} lower than those at the Trent River outflow from Rice Lake. (FIgure 31). Lower concentrations of phosphorus coupled with lower water export could limit the potential for phosphorus export from Sturgeon Lake in the autumn.

Table 37: Seasonal balance of the Sturgeon Lake phosphorus budget for 1986–89. All values in kg unless noted. Sediment contributions were not included in balance estimates.

Supply terms	1986–87				1987–88				1988–89			
	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr
Fenelon Falls	3307	5132	2189	3366	1339	1522	2336	4822	1622	2218	1449	5314
Emily	126.0	315.3	54.5	542.1	17.8	31.2	203.7	707.3	20.2	35.6	56.0	1335
Hawkers	59.0	96.3	36.7	117.6	30.5	25.9	59.5	160.2	13.2	19.1	21.6	261.2
McLaren	95.2	147.8	47.4	195.9	6.9	13.7	165.1	267.9	3.9	16.8	86.2	134.3
Martin	63.4	89.6	30.0	138.2	29.6	14.5	80.0	151.7	23.3	14.5	26.7	253.7
Rutherford	20.4	17.7	6.2	28.6	0.8	1.9	22.1	55.5	3.7	2.5	3.9	60.8
Scugog River	2163	3039	760	3015	820	1401	1752	2385	422	2028	860	3279
Lindsay STP	300	679	943	1116	669	767	781	1037	704	945	1405	1116
Lindsay WTP	6.5	4.3	4.1	2.2	6.6	3.9	3.2	1.9	6.1	3.7	4.7	1.8
Fenelon Falls STP	48.2	48.4	38.7	73.0	18.9	48.5	47.1	42.8	12.1	31.7	32.7	80.8
Springdale Gdns STP	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3
Ungauged	291.3	433.6	144.0	662.8	75.9	62.0	388.6	803.6	51.8	64.7	162.4	991.6
Precipitation	278	62	384	596	1680	163	456	474	1197	279	641	159
Shoreline	270	201	62	132	270	201	62	132	270	201	62	132
Sediments	2297	749	0	774	2297	749	0	774	2297	749	0	774
Urban Runoff	113.1	142.4	0.0	179.3	113.1	142.4	0.0	179.3	113.1	142.4	0.0	179.3
TOTAL	9451	11170	4713	10952	7389	5161	6370	12006	6772	6763	4825	14085
Loss terms												
Big Bob Channel	6481	10305	3641	9012	2762	2775	4729	7897	2420	2900	2050	12345
Fish Harvest	75.7	15.1	0.0	22.4	75.7	15.1	0.0	22.4	75.7	15.1	0.0	22.4
TOTAL	6557	10320	3641	9034	2838	2790	4729	7919	2496	2915	2050	12368
Storage	−57.5	−34.6	−97.1	326.1	−33.6	4.0	−127.2	154.2	−3.8	−35.6	−89.7	71.0
Balance (kg) (Out–In+Storage)	−2952	−885	−1169	−1592	−4584	−2367	−1768	−3932	−4280	−3884	−2865	−1647
Balance (%) (Out/In–Storage)	69%	92%	76%	85%	38%	54%	73%	67%	37%	43%	42%	88%

Phosphorus loads to Sturgeon Lake were more evenly distributed between different sources than for Rice Lake. The major inflow at Fenelon Falls contributed 39.1 ± 3.5% of the annual total on an average basis and the Scugog River 24.7 ±2.6%(Table 38). Small streams and ungauged portions of the immediate drainage area and point sources each added 12-13% of the total annual load. The combined contribution from shoreline loading, precipitation and urban runoff accounted for <12% of the total annual phosphorus load (Table 38).

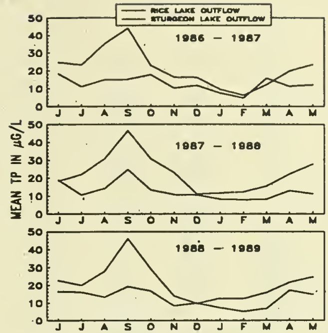


Figure 31: Monthly TP concentrations at the outflows from Rice and Sturgeon Lakes

There was little variation in the Fenelon Falls contribution to the Sturgeon Lake phosphorus budget between seasons. It was the dominant source in all seasons. The Scugog River's importance as a phosphorus source was lowest in the summer, mostly due to low flows but its load was significant in autumn and winter. The relative importance of loading from the immediate watershed (smaller streams) was increased with high flows in the spring.

The Scugog River and the minor streams in the immediate watershed contributed twice as much phosphorus per unit of water load as the major inflow at Fenelon Falls. (Table 39) This reflects the Precambrian Shield influence on loads from Fenelon Falls. Phosphorus load per unit of water load was twice as high in the summer as in all other seasons for the Scugog River and the minor tributaries (Table 39). The Fenelon Falls loads, by contrast, showed minor variation between seasons.

The absence of point sources on the Scugog River and the small tributary streams suggests that higher summer loads per unit of flow were due to other watershed activities such as agriculture or the concentration of phosphorus loads from ongoing sources such as septic fields during low flow periods. Phosphorus and water loads were most closely related in the summer as coefficients of determination (r^2) all exceeded 0.9 (Table 39). Phosphorus and water loads were not significantly related in the Fenelon Falls inflow in winter (r^2=0.43, $p<0.06$), and in the spring in both the Scugog River and minor tributaries in the immediate watershed ($p<0.13$, r^2>-0.3).

Table 38: Annual and seasonal variation in sources of phosphorus to Sturgeon Lake. All values are percentages of total load. Standard deviations are given in parentheses.

	Summer	Autumn	Winter	Spring	1986-87	1987-88	1988-89	Mean
Fenelon Falls	36.3 (10.0)	40.4 (7.9)	36.9 (8.2)	38.9 (5.1)	43.1	37.0	37.1	39.1 (3.5)
Minor Inflows	5.0 (3.6)	5.5 (4.4)	9.3 (4.2)	19.6 (3.2)	11.6	12.5	12.8	12.3 (0.6)
Scugog River	18.6 (10.6)	31.7 (2.3)	20.0 (6.1)	25.3 (4.3)	27.7	23.5	23.0	24.7 (2.6)
Point Sources	11.7 (5.9)	14.2 (6.2)	21.0 (8.1)	10.3 (1.4)	10.2	12.8	15.3	12.8 (2.6)
Shoreline	5.1 (1.2)	3.3 (1.3)	1.4 (0.5)	1.1 (0.3)	2.0	2.5	2.3	2.3 (0.2)
Precipitation	21.3 (15.4)	3.0 (2.1)	9.3 (3.2)	3.8 (2.4)	4.1	10.2	8.0	7.4 (3.1)
Urban Runoff	2.0 (0.5)	1.8 (0.7)	2.0 0.3	1.0 (0.1)	1.3	1.6	1.5	1.5 (0.1)

Shoreline development and urban runoff contributed <4% of the annual phosphorus load to Sturgeon Lake and 7% of the summer load. Precipitation added 21.3% of the summer, 9.3% of the winter load and 7.4% of the mean annual total. Summer fish harvest removed 75.7 kg of phosphorus (Table 37) or 2.3% of the total.

Release of phosphorus from Sturgeon Lake sediments may be a significant component of the total budget. Total annual release was estimated as 3819 tonnes (Table 34), and sediments were the primary source of phosphorus in the summer months (Table 37).

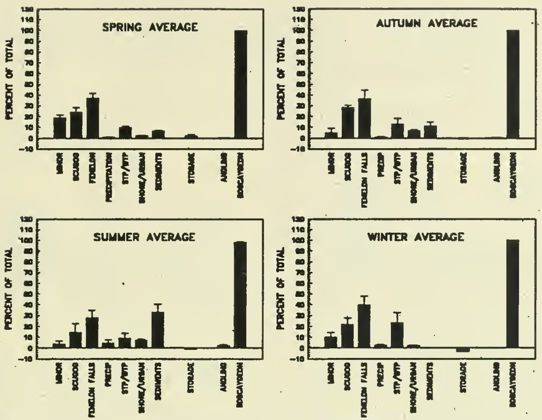


Figure 32: Seasonal point source loadings to Sturgeon Lake expressed as a percent of the total.

These figures, however, are estimates based on laboratory measurements of phosphorus release and tend to be highly variable. Release rates determined by similar methods were 5 to 10 times higher for the Bay of Quinte (Minns et al. 1986). Occasional periods of anoxia in Sturgeon Lake (Hutchinson et.al. 1994b) may have released further phosphorus to the water but this would not be included in the present estimate. In any event, Sturgeon Lake was a net sink for phosphorus year round. The net retention of phosphorus was therefore more important than any release from the sediments and so the sediment contribution was not included in any budget calculations.

Point source loadings of phosphorus to Sturgeon Lake included sewage treatment facilities in Lindsay and Fenelon Falls, the Lindsay water filtration plant and the Ops township STP at Springdale Gardens. Loading from shoreline development was included as a point source because it represented a potential source of phosphorus control into the lake. All point sources discharged directly to Sturgeon Lake except for the Lindsay WTP which was included as part of the Scugog River load.

Point sources added 4.7, 4.9 and 5.9 tonnes of phosphorus to Sturgeon Lake in each of the three study years. These loadings made up 14.7 to 20.4% of the TP load to Sturgeon Lake. The Lindsay STP was the largest single point source, adding 3.0 to 4.2 tonnes per year or 66.9 ± 3.9% of the total point source loading. Shoreline loading accounted for an additional 1023 kg (22 ± 2% of point source totals). The sewage treatment facilities at Fenelon Falls and Springdale Gardens were minor sources (4.4% of point source totals) and added less phosphorus to Sturgeon Lake than the amount estimated from urban runoff in Lindsay and Fenelon Falls (435 kg/yr, 7.4-9.1% of point source total). Point source loadings are summarized in Tables 3.25 and 3.26 of Appendix 3.

Table 39: Relationships between water and phosphorus loads for the Fenelon Falls,Scugog River and combined streams of the immediate watershed of Sturgeon Lake. Regressions were calculated from monthly totals for seasonal and annual periods

	n	r^2	p	Regression Equation
Fenelon Falls				
Annual	36	.87	.000001	TP kg=(m^3 x 10.2) - 181
Summer	9	.93	.00002	TP kg=(m^3 x 13.1) - 431
Autumn	9	.78	.002	TP kg=(m^3 x 7.8)- 169
Winter	9	.43	.06	TP kg= (m^3 x 10.1) - 314
Spring	9	.98	.000001	TP kg= (m^3 x 10.8) - 218
Scugog River				
Annual	36	.51	.000001	TP kg= (m^3 x 26.4 -) 146
Summer	9	.95	.00001	TP kg=(m^3 x 48.6) - 39
Autumn	9	.63	.01	TP kg=(m^3 x 29.8)- 171
Winter	9	.69	.005	TP kg= (m^3 x 20.6) - 50
Spring	9	.32	.11	TP kg= (m^3 x 22.1) - 429
Watershed				
Annual	36	.68	.000001	TP kg=(m^3 x 23.2) - 24
Summer	9	.99	.000001	TP kg= (m^3 x 33.4)- 6.1
Autumn	9	.87	.0003	TP kg= (m^3 x 6.7) - 4.1
Winter	9	.60	.015	TP kg= (m^3 x 20.3) - 18.1
Spring	9	.30	.13	TP kg=(m^3 x 19.5) - 177

Point sources represented significant loadings to Sturgeon Lake in some seasons. Point sources made up 28.3 and 33.8% of the total Sturgeon Lake phosphorus load in the winters of 1987 and 1989, 28.3% in the autumn of 1987 and >20% in the summers of 1987 and 1988. (Table 3.25, Appendix 3). The Lindsay STP was an extremely important point source of phosphorus in some seasons. It made up 77 and 83% of the point source total in the winter of 1987 and 1989 respectively. The STP load averaged 10% of the total phosphorus load to Sturgeon Lake and 20% in the winter (Fig. 33) Shoreline residences added 1.5-5.0% of the seasonal phosphorus loading to Sturgeon Lake and these values were highest in the summer. Urban runoff loadings averaged 2% of the total in all seasons but winter (Fig. 33) Loadings from the Fenelon Falls and Springdale Gardens STPs were insignificant (<1%).

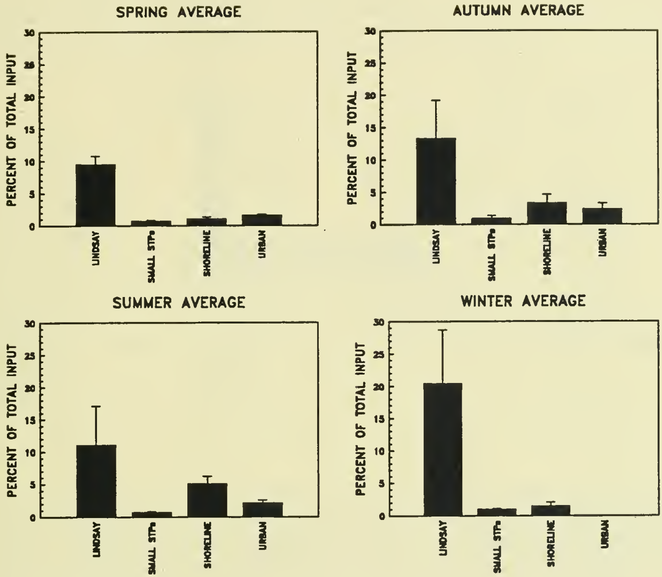


Figure 33: Seasonal point source phosphorus loads to Sturgeon Lake.

Phosphorus loads to Sturgeon Lake from individual sources are given in Figures 34 & 35 and Table 42 as loading per unit area of source. Precipitation loadings averaged 45.1 ± 15.7 mg/m^2 of lake surface per year, which is higher than the 21.7 mg/m^2 reported for lakes 100 km to the northwest in the Dorset area (Dillon et al 1992). Precipitation loading was highest in the summer (Figure 35) and lowest in the autumn. Martin Creek, Dunsford Creek and the Scugog River had high annual phosphorus export (7.6 - 8.8 mg/m^2/yr, Table 42). McLaren, Hawkers and Emily Creek exported 6.8 - 7.4 mg/m^2/yr. Rutherford Creek had the lowest export figure (4.1 ± 0.3 mg/m^2/yr) of the small creeks. The inflow at Fenelon Falls added 3.6 ± 0.7 mg/m^2/yr, a low value which reflects Precambrian shield drainage. Areal loadings from all sources but precipitation were highest in the spring which confirms that phosphorus and water loads were closely related. Remaining sources showed little variation between export in summer, autumn and winter (Figure 35)

Urban runoff added 54.2 mg/m^2 of phosphorus per year from 803 ha of developed area. The highest areal load was from 273 ha of developed shoreline which added 244 mg/m^2 per year .

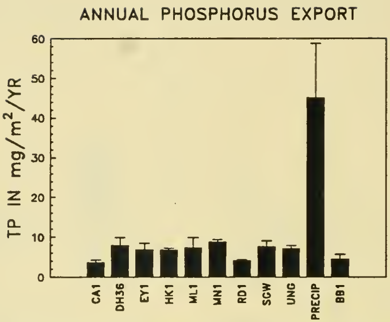


Figure 34: Annual export for sources of phosphorus to Sturgeon Lake expressed as mg/m^2/yr.

Phosphorus retention within Sturgeon Lake produced a total annual export of 4.5$\pm$1.2 mg of phosphorus per m^2 of watershed at the Bobcaygeon outflow. Phosphorus export per m^2 of lake surface was 476$\pm$130 mg/yr compared to 522$\pm$136 mg/yr for Rice Lake. Total areal loading to Sturgeon Lake was 624$\pm$59 mg/m^2/yr compared to 708$\pm$85 mg/m^2/yr for Rice Lake. Fish harvest removed 2.4 mg/m^2/yr and so net annual retention of phosphorus in Sturgeon Lake ws 145 $\pm$72 mg/m^2 of surface area. This is similar to the value of 173 $\pm$ 55 which was estimated for Rice Lake.

The 1986-89 phosphorus budget for Sturgeon lake is summarized and compared to the 1975-76 budget in Table 45. The most notable comparison is the apparent reduction in phosphorus load from 45 tonnes in 1975-76 to 29 tonnes in 1986-89. There are several reasons to suggest, however, that the 1975-76 budget was in error and that no conclusions should be made regarding changes in load.

The apparent changes were the result of reductions in phosphorus inputs from 'Main Channel','Land Drainage' and 'Local' or point sources. Main channel loading by way of Fenelon Falls showed an apparent decrease from 19.6 to 18.8 tonnes between the two studies. These loads were estimated for the 1975-76 study on the basis of bi-weekly measurements of water chemistry and linear interpolation of daily concentrations. Lower loads in the present study may reflect more frequent measurements and more sensitive analysis for phosphorus which was introduced by MOE in 1981.

Table 40: Mean annual export of total phosphorus, chloride and potassium from streams in the Sturgeon Lake watershed. Values are mg/m^2 of watershed area except precipitation (mg/m^2 of lake surface), urban (mg/m^2 of developed area) and shoreline (mg/m^2 of developed shoreline). Standard deviations of 3 years are in parentheses.

	Total Phosphorus	Chloride	Potassium
Fenelon Falls	3.56 (0.66)	1731 (105)	348 (47)
Dunsford Creek	7.94 (1.98)	6677 (2314)	531 (167)
Emily Creek	6.88 (1.57)	3859 (288)	482 (37)
Hawkers Creek	6.77 (0.48)	1659 (365)	412 (106)
McLaren Creek	7.37 (2.49)	5283 (1114)	628 (275)
Martin Creek	8.78 (0.73)	3034 (959)	344 (112)
Rutherford Creek	4.10 (0.28)	1424 (186)	237 (95)
Scugog River	7.58 (1.50)	4490 (1079)	498 (160)
Ungauged	7.24 (0.72)	7183 (1589)	463 (156)
Precipitation	45.1 (15.7)	234 (23)	72 (62)
Urban runoff	54.2 (0)	--	--
Shoreline	244 (0)	--	--
Big Bob Channel	4.53 (1.23)	2694 (354)	388 (83)

Table 41 : Comparison of Sturgeon Lake phosphorus budgets for 1975-76 and 1986-89. All loads are in metric tonnes per year. 1975-76 data are taken from MOE (1976). Derivations of loadings are explained in footnotes.

	Main Channel	Land Drainage	Precipitation	Local	Total
1975-76	19.6[1]	13.1[3]	1.05	11.1[4]	44.9
1986-89	18.8[1]	3.6[2]	2.1	4.8[4]	29.3

1. Major inflow at Fenelon Falls and Scugog River.
2. Immediate watershed- gauged tributaries& ungauged area.
3. Estimated from Ouse River and Nogies creek data
4. All point sources, shoreline development and urban runoff

In the 1976 study, land drainage inputs were estimated for ungauged portions of the Sturgeon Lake watershed including the Scugog River using data from Nogies Creek and the Ouse River. In the present study most of this loading was measured directly and only 19,032 ha of the total watershed area of 476,377 ha was estimated. This was done by prorating loadings from 5 small creeks in the immediate watershed and represents a more accurate estimate.

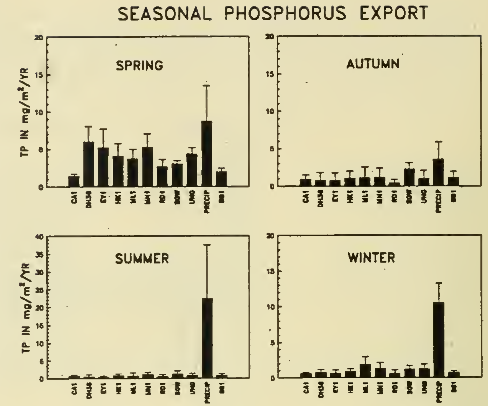


Figure 35: Seasonal export for sources of phosphorus to Sturgeon Lake expressed as mg/m^2/yr.

Higher precipitation loads may reflect inclusion of both wet and dry TP loads in the present study or changes in phosphorus analysis techniques. Decreased contribution from point sources is significant and reflects improvements in TP removal at STPs in Lindsay and Fenelon Falls. Both studies estimated TP loads from septic systems on the basis of user surveys and assumptions of per capita phosphorus additions. The 1976 study used 1.3 kg TP per person per year and the assumption that 80% of that was retained in septic fields. The present study used a per-capita figure of 0.8 kg and assumed less retention.

In summary; errors in the 1975-76 budget and poor resolution of the data presented in the 1976 report prevent making conclusions regarding changes in loadings between the two studies. There is evidence, however, of improvements in sewage treatment facilities.

Sturgeon Lake: Chloride budget

The chloride budget for Sturgeon Lake was calculated to verify the accuracy of the phosphorus budget. Chloride, a conservative ion, will not be taken up by vegetation, lost to lake sediments or modified by other watershed processes. Initial estimates produced chloride balances (as output/input-storage) of 108%, 97%, and 100% in 1986-87, 1987-88 and 1988-89 respectively (Table 42) Correcting these balances for flow by balancing the hydrology budget produced figures of 101%, 98% and 107% (mean = 102 ± 4.5%, Table 43). This verifies that the mass budget methodology was sound and would have included all relevant sources and losses of chloride to Sturgeon Lake. It also infers that the phosphorus budget was sound and that differences between loss and supply were due to sedimentation and retention of TP within Sturgeon Lake.

Table 42: Annual chloride balance for Sturgeon Lake for 1986–89.
All values in tonnes unless noted.

Supply terms

	1986–1987	1987–1988	1988–1989
Fenelon Falls	5809	5224	5818
Emily	630	605	698
Hawkers	81	55	85
McLaren	348	232	267
Martin	111	70	136
Rutherford	28	22	28
Scugog River	5099	4737	3144
Lindsay STP	645	616	629
Lindsay WTP	0.52	0.50	0.10
Fenelon Falls STP	18.0	17.5	17.3
Springdale Gdns STP	9.00	8.59	8.77
Ungauged	1540	1018	1543
Precipitation	10.0	11.0	12.1
Shoreline	31.4	25.3	42.0
TOTAL	14359	12641	12428

Loss terms

Big Bob Channel	15360	12230	12420
TOTAL	15360	12230	12420

Storage	86	12	22
Balance (Out–In+Storage)	1087	–399	14
Balance (%) (Out/In–Storage)	108%	97%	100%

Net export of chloride in spring and summer ranged from 102.5 to 125.7%. Autumn and winter balances ranged from 73 to 100.5% (Table 45), indicating that retention in these seasons balanced export in spring and summer to produce an overall balance on an annual basis. The autumn and spring balances of chloride(87.5 and 118.1%) matched those of the hydrology budget in direction and magnitude (88.9 and 113.6%) suggesting that hydrology was the dominant function determining the chloride balance in those seasons. Hydrology and chloride balances on average were not matched in winter and summer. Summer hydrology balances were negative and chloride balances positive, suggesting that chloride concentrations determined the summer balance. Winter balances tended to be positive for hydrology and negative for chloride.

Table 43: Annual and seasonal balances of the chloride budget for Sturgeon Lake in 1986-87, 1987-88 and 1988-89. All balances are presented as percentages (output/input-storage), following correction for water balance.

	Summer	Autumn	Winter	Spring	Annual
1986-87	102.5	100.5	78.5	111.3	101.2
1987-88	113.1	73.0	77.1	125.7	97.9
1988-89	107.4	89.0	84.6	117.2	106.8
Mean	107.6	87.5	80.1	118.1	**102**
(S.D.)	(5.3)	(13.8)	(4.0)	(7.2)	**(4.5)**

Supply of chloride to Sturgeon Lake from all sources ranged from 12,428 tonnes in 1988-89 to 14,359 tonnes in 1986-87 (Table 44): approximately half of the supply to Rice Lake. Lower loadings reflect the dominance of dilute Precambrian Shield water in the Sturgeon Lake budget and the differences in size of the watersheds of the two lakes. The high supply of chloride in 1986-87 reflected the high water supply in that year. Water yield was 53% in 1986-87 compared to 40% and 36% in the final two years.

The Scugog River and the Fenelon Falls inflow provided 68 to 83% of the chloride load to Sturgeon Lake, depending on the season. The Fenelon Falls inflow was most important in summer and spring, but the Scugog River provided approximately 40% of the chloride in winter (Figure 36) and autumn. Chloride load from the immediate watershed ranged from 6% in summer to 26% in spring. Point sources, including shoreline development added 6-10% of the total chloride in each season and precipitation loading was trivial. Point sources were less important to the Sturgeon lake budget than to Rice Lake. Point sources of chloride (6-10%) and TP (9-13%) to Sturgeon Lake were similar in all seasons but winter when point source TP loading was significant. In contrast, point sources added 6-8% of the chloride load to Rice Lake, but 25-28% of the TP load.

Chloride export per unit of watershed area was lowest and least variable for the Fenelon Falls inflow (Figure 37). Dunsford Creek showed the most variable chloride export (300mg $\circ$ m^{-2} in summer to 4200 mg $\circ$ m^{-2} in spring. McLaren Creek, the Scugog River and Dunsford Creek all showed higher chloride yields than Martin, Hawkers, Rutherford and Emily Creeks. Overall chloride export was highest in the spring reflecting the dominant role of hydrology in determining chloride export.

Table 44: Seasonal chloride budget for Sturgeon Lake. All values in tonnes unless noted.

Supply terms	1986–87				1987–88				1988–89			
	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr
Fenelon Falls	1390	1984	1048	1387	831	712	1471	2210	902	1078	1083	2754
Emily	44.4	173.6	50.1	361.5	7.3	24.0	205.7	368.4	10.7	51.5	104.9	531.2
Hawkers	6.0	32.0	16.0	26.8	3.1	6.0	20.5	25.4	2.2	10.9	20.8	51.0
McLaren	34.8	103.5	56.6	152.7	2.0	13.6	116.3	99.8	2.4	48.2	92.4	124.1
Martin	8.9	40.6	16.0	45.2	4.6	6.2	22.4	36.6	6.0	17.8	36.3	75.7
Rutherford	5.2	8.2	4.5	10.2	0.2	1.8	8.6	11.3	4.6	2.7	6.3	14.2
Scugog River	663	1599	1307	1530	265	1245	2236	991	131	565	893	1555
Lindsay STP	144	132	174	195	142	128	159	187	146	127	165	191
Lindsay WTP	0.1	0.1	0.2	0.1	0.2	0.0	0.2	0.1	0.1	0.0	0.0	0.0
Fenelon Falls STP	2.6	3.3	4.6	7.4	2.6	2.9	4.8	7.3	2.6	2.9	4.4	7.4
Springdale Gdns STP	2.0	1.8	2.4	2.7	2.0	1.8	2.2	2.6	2.0	1.8	2.3	2.7
Ungauged	153	484	232	672	26	69	421	502	41	214	403	886
Precipitation	2.1	0.5	3.2	4.3	1.4	1.7	6.0	2.0	1.0	1.8	7.0	2.3
Shoreline	9.5	13.2	2.7	6.0	10.6	5.8	2.5	6.4	6.8	7.0	3.4	24.8
TOTAL	2465	4575	2917	4401	1297	2217	4676	4450	1259	2127	2822	6220
Loss terms												
Big Bob Channel	2244	4860	2576	5682	1226	1315	3815	5877	1010	1528	2006	7871
TOTAL	2244	4860	2576	5682	1226	1315	3815	5877	1010	1528	2006	7871
Storage	−19.5	−13.3	−98.5	217.1	−13.8	3.3	−104.9	127.5	−2.9	−17.9	−99.7	142.7
Balance (kg) (Out−In+Storage)	−241	271	−439	1497	−86	−899	−966	1554	−251	−618	−915	1794
Balance (%) (Out/In−Storage)	90%	106%	85%	136%	93%	59%	80%	136%	80%	71%	69%	130%

Table 45: Annual Sturgeon Lake chloride point source summary.
All values in kg unless noted

Sturgeon Lake Point Sources (kg)

	1986–1987	1987–1988	1988–1989
Lindsay STP	645481	615750	629108
Lindsay WTP	519	502	102
Fenelon Falls STP	18049	17531	17262
Springdale STP	9003	8588	8774
Shoreline Develop.	31377	25341	41964
Total	704429	667712	697210
% of Sturgeon Lake Total Loading	4.9	5.3	5.6

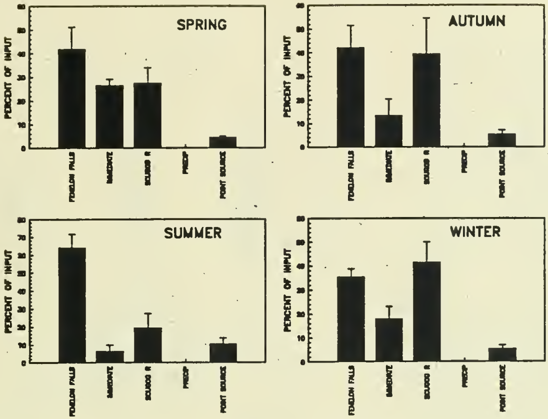


Figure 36: Seasonal loadings of chloride to Sturgeon Lake. All values are percentages of total input.

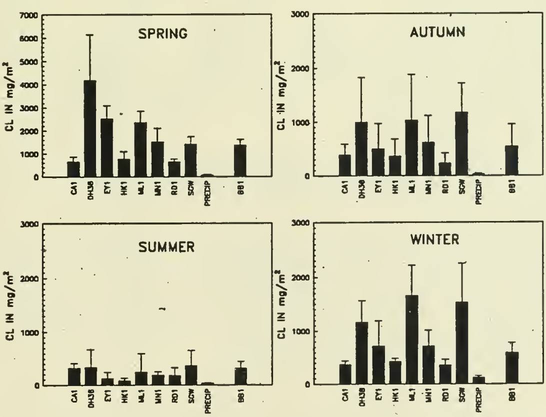


Figure 37: Seasonal export of chloride from Sturgeon Lake catchments expressed as mg /m^{2}of watershed / yr.

Sturgeon Lake: Potassium budget

A potassium budget was constructed to aid in the interpretation of the Sturgeon Lake phosphorus budget and for comparison with the Rice Lake potassium budget which reflected the presence of an extensive macrophyte community.

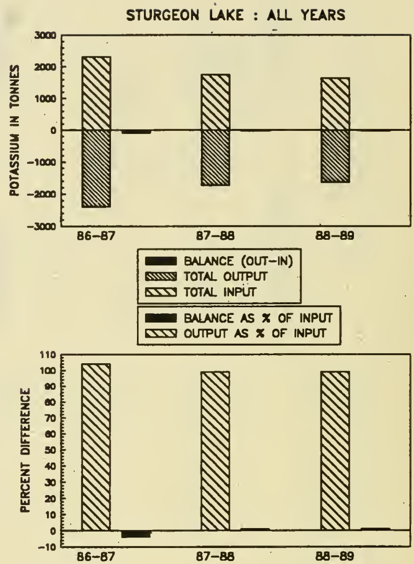


Figure 38: Annual potassium balance for Sturgeon Lake.

Initial estimates produced balances (output/input-storage) of 104%, 99% and 99% in 1986-87, 1987-88, and 1988-89 respectively. (Table 46, Figure 38). Balancing the hydrology budget adjusted these figures to 98%, 100% and 106% (Table 47). The close balance of input and loss terms indicates that all relevant terms were considered in the budget (Table 48). Potassium supply exceeded loss (net retention) in autumn and winter of each year(Table 47). Loss exceeded supply (net export) in spring and summer of all years.

The seasonal dynamics of potassium in Sturgeon Lake differed slightly from those in Rice Lake where retention was linked to low potassium concentrations and export to high concentrations. In Sturgeon Lake, potassium concentration at Bobcaygeon was not closely related to export and retention (Figure 39, top) suggesting that hydrology was more important than in lake processes such as macrophyte growth in determining phosphorus export. Potassium concentrations in Sturgeon Lake thus reflected the hydrologic cycle as shown in Figure 39 (bottom)

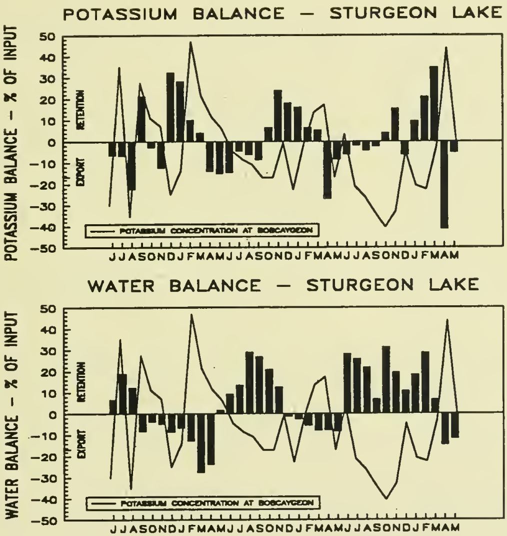


Figure 39: Monthly retention of potassium in Sturgeon Lake. Concentrations are indicated as relative changes, not as absolute concentrations.

Table 46: Annual potassium budget for Sturgeon Lake. All values in tonnes.

	1986-87	1987-88	1988-89
Supply terms			
Fenelon Falls	1307	1031	1050
Emily	81.8	73.7	85.7
Hawkers	23.6	14.8	16.3
McLaren	50.3	27.1	23.1
Martin	16.2	8.5	11.2
Rutherford	6.3	3.6	3.1
Scugog River	638	470	331
Lindsay STP	48	47	47
Lindsay WTP	0.002	0.002	0.001
Fenelon Falls STP	2.5	2.8	2.3
Springdale Gdns STP	0.7	0.7	0.7
Ungauged	122	67.7	74.2
Precipitation	6.8	1.8	1.7
Shoreline	4.2	3.0	4.4
TOTAL	2307	1752	1651
Loss terms			
Big Bob Channel	2394	1732	1636
TOTAL	2394	1732	1636
Storage	5.8	0.8	1.2
Balance (out-in+storage)	92.6	-19.3	-13.9
Balance (%) (out/in-storage)	104	99	99

Table 47: Annual and seasonal balances of the potassium budget for Sturgeon Lake in 1986-87, 1987-88 and 1988-89. All balances are percentages (output/input-storage), following correction for water balance.

	Summer	Autumn	Winter	Spring	Annual
1986-87	111.7	97.3	74.1	106.9	97.7
1987-88	108.9	80.4	85.5	114.0	100.0
1988-89	104.0	91.8	94.8	111.2	105.8
Mean (S.D.)	108.2 (3.9)	92.8 (5.0)	84.8 (10.3)	110.7 (3.6)	101.2 (4.2)

Table 48: Seasonal potassium budget for Sturgeon Lake for 1986–89. All values in kg unless noted.

Supply terms	1986–87				1987–88				1988–89			
	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr
Fenelon Falls	260203	422001	344585	279795	157126	144240	305802	423945	174262	196341	195747	483325
Emily	4473	25913	5122	46338	350	2408	24334	46618	890	3660	8577	72582
Hawkers	948	10209	3831	8633	784	1919	4628	7499	238	1447	2206	12424
McLaren	3542	18951	5101	22732	185	1492	12688	12714	147	4436	6767	11772
Martin	990	6428	1499	7262	607	757	2497	4662	379	1255	1603	7941
Rutherford	1140	2329	648	2177	37	227	1222	2070	316	229	453	2088
Scugog River	76565	235900	134809	191034	32098	93532	227585	117042	11376	59687	80420	179179
Lindsay STP	9858	10993	14200	12871	9713	11244	13396	12893	9996	10746	13747	12879
Lindsay WTP	0	0	2	0	0	0	2	0	0	0	1	0
Fenelon Falls STP	640	539	645	667	657	595	776	778	628	563	703	722
Springdale Gdns STP	137	153	198	180	135	157	187	180	139	150	192	180
Ungauged	7631	47512	13550	53466	1921	5048	25845	34908	1299	9091	13275	50552
Precipitation	998	739	284	4754	830	382	145	408	912	237	285	220
Shoreline	1302	2099	299	486	1333	887	280	499	915	1091	368	1987
TOTAL	368429	783766	524770	630392	205777	262887	619387	664214	201497	288932	324342	835851
Loss terms												
Big Bob Channel	366630	806800	437600	783150	187080	186750	561600	796900	156700	213970	260440	1004500
TOTAL	366630	806800	437600	783150	187080	186750	561600	796900	156700	213970	260440	1004500
Storage	−4162	−2722	−17591	30301	−2100	470	−15561	17946	−486	−2486	−14007	18164
Balance (kg) (Out−In+Storage)	−5961	20312	−104762	183060	−20797	−75667	−73348	150632	−45283	−77448	−77910	186813
Balance (%) (Out/In−Storage)	98%	103%	81%	131%	90%	71%	88%	123%	78%	73%	77%	123%

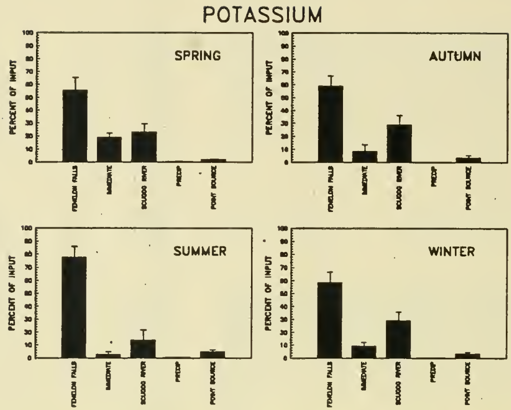


Figure 40: Average seasonal potassium loads to Sturgeon Lake as percents of input

Total potassium supply to Sturgeon Lake was 2307, 1752 and 1651 tonnes in 1986-87, 1987-88 and 1988-89 respectively (Table 46). The inflow at Fenelon Falls was the major source of potassium . This source provided 78 ± 8% of the total load in summer and 55-59% in other seasons for an annual average of 1129 tonnes (59%, Figure 40). The Scugog River added 480 tonnes or 25% of the annual total to Sturgeon Lake. (Table 49) It's contribution was lowest (14%) in summer and ranged from 22-28% in other seasons (Figure 40). The small streams in the immediate watershed were minor sources of potassium. They added 237 tonnes annually (Table 48) or 12% of the total and their contribution was greatest in the spring. (Figure 40) Precipitation loading to the lake surface was a trivial component of the potassium budget adding 3.4 tonnes annually or less than 1% of the total.

Point source loadings of potassium to Sturgeon Lake were low. Annual point source totals were 54-55 tonnes or 2.4-3.3% of the total (Table 49). The Lindsay STP was the largest point source. Its annual load of 47 tonnes made up 87% of the point source total but only 2.1-2.9% of the total load to the lake. The potassium load from shoreline development was estimated as 3-4.3 tonnes per year. Seasonal contributions from point sources ranged from 2.1% in spring to 5.8% in summer (Appendix 3, Table 3.32).

Potassium export per unit area of watershed was highest in spring and lowest in summer, reflecting seasonal differences in water yield. (Figure 41). Between stream comparisons showed differing degrees of variability in potassium export. The major inflows, Fenelon Falls and Scugog River, the outflow at Bobcaygeon and Rutherford Creek showed 2-4 fold differences in yield between seasons. Rutherford Creek had the lowest absolute level of export. McLaren and Martin Creeks showed 10 and 12 fold differences in seasonal yield. Hawkers, Dunsford and Emily Creeks were highly variable. Summer yield from these watersheds was the lowest of all watersheds studied (9-15 $mg.m^{-2}$). Autumn and winter yields were intermediate. Spring yields from Dunsford and Emily Creeks were higher than all other watersheds, averaging 330-350 $mg.m^{-2}$. Dunsford and McLaren Creeks and the Scugog River had high year- to- year variability suggesting that yield of potassium was closely related to water yield.

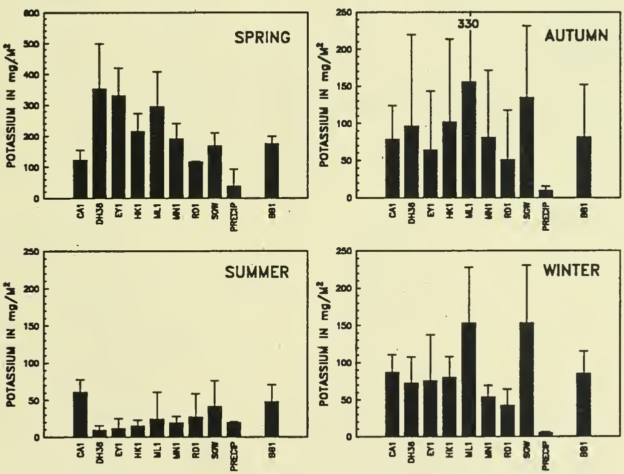


Figure 41: Seasonal potassium export per unit area of watershed for Sturgeon Lake.

Table 49: Annual Sturgeon Lake point source budget summaries.

Sturgeon Lake Point Sources (kg)	1986-87	1987-88	1988-89
Lindsay STP	47922	47246	47368
Lindsay WTP	59	75	35
Fenelon Falls STP	2490	2805	2617
Springdale STP	668	659	661
Shorline Develop.	4185	2998	4361
TOTAL	55324	53784	55041
%of Sturgeon Lake total loading	2.1	2.7	7.95

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Ms. Kathy Hooper	Bewdley South and Bewdley North
Mr. Jim Forde	Ouse River
Mr. Murray Black	Indian River
Mr. Roy Legassicke	Otonabee River
Mr. Steve Wright	Trent River
Mr. Brent Kaltwasser	Trent River
Reed and Loretta Clark	Scugog River
Mr. Harold Snider	McLaren Creek
Mr. Duncan Walls	Rutherford Creek
Mrs. Vivian Wilson	Martin and Hawkers Creeks
Mr. Ken Geary	Emily and Dunsford Creeks
Mr. Bob Brown	Big Bob Channel at Bobcaygeon
Mr. Tim Goodison	Fenelon Falls

REFERENCES

Beak Consultants Ltd, 1994. Release of phosphorus from Rice Lake sediments. Rice and Sturgeon Lakes Nutrient Budget Study, Report 8, Feb. 1988. 31pp

Dillon, P.J., K.H. Nicholls, W.A. Scheider, N.D. Yan and D.S. Jeffries. 1986. Lakeshore Capacity Study, Trophic Status - Final Report, Research and Special Projects Branch, Ont. Min. Municip. Affairs, Queen's Printer for Ontario. 89 pp.

Dillon P.J., R.A. Reid and H.E. Evans. 1992. The relative magnitude of phosphorus sources for small, oligotrophic lakes in Ontario, Canada. Ontario Ministry of the Environment, Queen's Printer for Ontario, ISBN 0-7778-0168-X. Log 92-285-109, 11pp

Dillon P.J., W.A. Scheider R.A. Reid and D.S. Jeffries. 1994. The Lakeshore Capacity Study. Part I : a test of the effects of shoreline development on the trophic status of lakes. Lake Reserv. Mgt. : in press.

Downing, J.C. 1986. Lakeshore Capacity Study, Land Use- Final Report, Research and Special Projects Branch, Ontario Ministry of Municipal Affairs, Queen's Printer for Ontario. 43pp.

Environment Canada 1981. Canadian Climate Normals, 1951-1980, Temperature and Precipitation, Ontario, Canadian Climate Program Publication, Atmospheric Environment Service. UPC: 551,582(713) 254pp.

Fisheries and Env. Canada 1978. Hydrologic Atlas of Canada, Dept. of Supply and Services Canada, EN37-26/1978, Ottawa, Canada.

Hutchinson B.A. and C.D. Snell. 1994. Mass balance measurements for study watersheds at the Dorset Research Centre : Methodology (1976-1992). MOEE DR/94-*.

Hutchinson N.J., B.J. Clark,, J.R. Munro and B.P. Neary 1994a. Hydrological data for the watersheds of Rice Lake and Sturgeon Lake, 1986 - 1989. Rice & Sturgeon Lakes Nutrient Budget Study, Report 1, 100 pp.

Hutchinson N.J., J.R. Munro, B.J. Clark and B.P. Neary. 1994b. Water chemistry data for Rice Lake, Sturgeon Lake and their respective catchments, 1986-1989. Rice & Sturgeon Lakes Nutrient Budget Study, Report 2, 169 pp.

Hutchinson N.J., K.H. Nicholls & S. Maude. 1994d Rice & Sturgeon Lake Nutrient Study: Summary and Recommendations. Rice & Sturgeon Lakes Nutrient Budget Study, Report 13.

Kawartha Region Conservation Authority 1982. Watershed Management Strategy, December 1982, 297pp.

Kitchell, J.F., J.F. Koonie and P.S. Tennis. 1975. Phosphorus flux through fishes. Verh. Internat. Verein. Limnol. 19: 1478-2484.

Kortmann, R.W. 1988. Septic systems and how they affect lakes. Lake Line 8(6) : 8-18.

Minns, C.K., G.E. Owen and M.G. Johnson. 1986. Nutrient loads and budgets in the Bay of Quinte, Lake Ontario, 1965-81. Can. Spec. Publ. Fish. Aquat. Sci. 86 : 270p.

Nurnberg, G.K. 1984. The prediction of internal phosphorus load in lakes with anoxic hypolimnia. Limnol. Oceanogr. 29(1) : 111-129.

Ontario Ministry of the Environment, 1985. Acidic Precipitation in Ontario Study (APIOS), An overview: the cumulative wet/dry deposition network, 2nd revised edition, Air Resources Branch, MOE, Oct. 1985. #ARB-141-85-AQM. APIOS-024-85.

Ontario Ministry of the Environment, 1988, Performance Report - Water Quality Section. May, 1989. 410 pp.

Ontario Ministry of the Environment and Ontario Ministry of Natural Resources, 1976. The Kawartha Lakes Water Management Study- Water Quality Assessment (1972-1976) November 1976, 185pp.

Ontario Ministry of the Environment, 1987. report on the 1986 discharges from municipal wastewater treatment facilities in Ontario, Municipal Section, MISA Office, Water Resources Branch. ISSN #0835-7552 467pp.

Sullivan, R.H., W.D.Hurst , T.M. Kipp, J.P. Heany, W.C Huber and S. Nix, Evaluation of the Magnitude and Significance of Pollution from Urban Storm Water Runoff in Ontario, Research program for the abatement of municipal polluiton under the provisions of the Canada-Ontario agreement on Great Lakes water quality, Project No. 75-8-33, Ontario Ministry of the Environment, Polution Control Branch, 135 S. Clair Ave.West, Toronto, Ont.

Waller, D.H. and Z. Novak, Municipal Pollutant Loadings to the Great Lakes from Ontario Communities, Research program for the abatement of municipal polluiton under theprovisions of the Canada-Ontario agreement on Great Lakes water quality, Project No. 75-8-33, Ontario Ministry of the Environment, Polution Control Branch, 135 St.Clair Ave. West, Toronto, Ont.

APPENDIX 1

APPENDIX 2

APPENDIX 3

APPENDIX 4

APPENDIX 5

Table 1.1 : Monthly summary of Discharge and Total Phosphorus, Potassium and Chloride loadings to Rice Lake from the Bewdley North inflow, 1986-89. Loadings are in total kg and mg per m2 of watershed area.

Bewdley North

Month	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
8606	0.247	14.6	2.31	180	28.5	1260	200
8607	0.125	5.9	0.94	84	13.4	469	74
8608	0.138	5.0	0.79	106	16.8	673	107
8609	0.179	4.6	0.73	163	25.9	855	136
8610	0.161	3.8	0.60	147	23.2	804	127
8611	0.149	4.1	0.64	142	22.6	521	83
8612	0.194	9.6	1.52	150	23.7	923	146
8701	0.141	8.2	1.30	105	16.6	585	93
8702	0.110	4.5	0.71	90	14.2	488	77
8703	0.236	13.5	2.14	207	32.8	1534	243
8704	0.229	6.8	1.08	181	28.7	1545	245
8705	0.124	4.2	0.67	73	11.5	336	53
8706	0.112	5.4	0.85	49	7.7	243	39
8707	0.110	4.7	0.75	90	14.3	344	55
8708	0.094	3.9	0.61	63	10.0	375	59
8709	0.101	4.3	0.67	109	17.3	630	100
8710	0.133	5.6	0.88	143	22.6	716	113
8711	0.176	5.3	0.85	180	28.5	1032	164
8712	0.156	4.2	0.66	137	21.7	943	149
8801	0.235	14.4	2.28	275	43.6	793	126
8802	0.197	9.9	1.56	234	37.0	2504	397
8803	0.246	17.3	2.75	286	45.4	1291	205
8804	0.214	6.1	0.97	214	33.9	1256	199
8805	0.166	5.9	0.93	121	19.2	705	112
8806	0.131	7.5	1.19	77	12.3	464	73
8807	0.080	4.0	0.63	58	9.1	225	36
8808	0.099	4.7	0.74	67	10.6	372	59
8809	0.123	13.4	2.13	130	20.6	1181	187
8810	0.127	3.3	0.53	157	24.9	656	104
8811	0.123	4.2	0.67	152	24.1	670	106
8812	0.148	6.4	1.01	158	25.1	811	128
8901	0.181	9.7	1.54	243	38.4	1245	197
8902	0.118	6.6	1.05	167	26.4	769	122
8903	0.245	12.2	1.93	313	49.6	3200	507
8904	0.160	4.7	0.74	193	30.6	1457	231
8905	0.167	4.1	0.64	173	27.4	1133	180

Table 1.2 : Seasonal and annual summary of Discharge and Total Phosphorus, Potassium and Chloride loadings to Rice Lake from the Bewdley North inflow, 1986-89. Loadings are in total kg and mg per m2 of watershed area.

Bewdley North

	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
summer 1986	0.510	25.5	4.04	370	58.7	2402	381
autumn 1986	0.490	12.5	1.97	452	71.7	2181	346
winter 1987	0.445	22.3	3.53	344	54.5	1997	316
spring 1987	0.589	24.5	3.89	461	73.0	3415	541
TOTAL	2.033	84.8	13.43	1628	257.9	9994	1584
summer 1987	0.316	14.0	2.21	202	32.0	962	153
autumn 1987	0.411	15.2	2.40	432	68.4	2378	377
winter 1988	0.588	28.4	4.51	645	102.3	4240	672
spring 1988	0.625	29.3	4.65	622	98.5	3252	515
TOTAL	1.941	86.9	13.77	1901	301.2	10833	1717
summer 1988	0.309	16.2	2.56	202	32.0	1061	168
autumn 1988	0.373	20.9	3.32	439	69.6	2507	397
winter 1989	0.448	22.7	3.60	568	89.9	2825	448
spring 1989	0.572	20.9	3.31	680	107.7	5790	918
TOTAL	1.702	80.7	12.79	1888	299.2	12182	1931

Table 1.3: Monthly summary of Discharge and Total Phosphorus, Potassium and Chloride loadings to Rice Lake from the Bewdley South inflow, 1986-89. Loadings are in total kg and mg per m2 of watershed area.

Bewdley South

Month	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
8606	0.199	47.5	2.14	259	11.6	931	42
8607	0.174	7.0	0.32	226	10.2	734	33
8608	0.195	11.7	0.53	333	15.0	790	36
8609	0.277	23.6	1.06	559	25.2	2153	97
8610	0.260	15.7	0.71	469	21.1	2302	104
8611	0.219	11.8	0.53	401	18.0	1345	61
8612	0.325	18.7	0.84	549	24.7	2625	118
8701	0.268	8.2	0.37	340	15.3	1561	70
8702	0.190	7.2	0.32	249	11.2	868	39
8703	0.651	108.3	4.88	1939	87.3	7014	316
8704	0.577	50.8	2.29	1498	67.5	5623	253
8705	0.231	7.2	0.32	326	14.7	1062	48
8706	0.195	8.4	0.38	263	11.8	789	36
8707	0.184	8.2	0.37	206	9.3	609	27
8708	0.154	5.1	0.23	226	10.2	600	27
8709	0.149	21.1	0.95	446	20.1	716	32
8710	0.161	6.9	0.31	258	11.6	758	34
8711	0.178	37.5	1.69	425	19.1	1150	52
8712	0.258	33.4	1.50	557	25.1	1737	78
8801	0.422	342.9	15.45	1896	85.4	2321	105
8802	0.268	65.1	2.93	923	41.6	1706	77
8803	1.895	880.7	39.67	7973	359.1	11640	524
8804	0.293	15.6	0.70	615	27.7	2376	107
8805	0.184	4.6	0.20	264	11.9	757	34
8806	0.147	8.6	0.39	248	11.1	614	28
8807	0.141	10.0	0.45	186	8.4	540	24
8808	0.152	5.9	0.27	222	10.0	622	28
8809	0.167	4.7	0.21	235	10.6	709	32
8810	0.154	5.9	0.27	303	13.6	877	39
8811	0.161	11.0	0.49	296	13.3	922	42
8812	0.196	9.5	0.43	648	29.2	1283	58
8901	0.496	126.1	5.68	2551	114.9	5240	236
8902	0.734	285.7	12.87	4771	214.9	6469	291
8903	0.709	112.6	5.07	3115	140.3	6084	274
8904	0.156	8.2	0.37	342	15.4	1211	55
8905	0.245	6.1	0.28	398	17.9	2424	109

Table 1.4: Seasonal and annual summary of Discharge and Total Phosphorus, Potassium and Chloride loadings to Rice Lake from the Bewdley South inflow, 1986-89. Loadings are in total kg and mg per m2 of watershed area.

Bewdley South

	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
summer 1986	0.567	66.2	2.98	818	36.8	2456	111
autumn 1986	0.756	51.1	2.30	1429	64.4	5800	261
winter 1987	0.782	34.0	1.53	1138	51.3	5054	228
spring 1987	1.459	166.3	7.49	3763	169.5	13699	617
TOTAL	3.565	317.6	14.31	7148	322.0	27008	1217
summer 1987	0.532	21.6	0.97	694	31.3	1999	90
autumn 1987	0.488	65.4	2.95	1129	50.8	2624	118
winter 1988	0.948	441.4	19.88	3375	152.0	5764	260
spring 1988	2.372	900.9	40.58	8852	398.7	14773	665
TOTAL	4.339	1429.4	64.39	14050	632.9	25160	1133
summer 1988	0.440	24.6	1.11	655	29.5	1776	80
autumn 1988	0.482	21.6	0.97	833	37.5	2508	113
winter 1989	1.425	421.3	18.98	7970	359.0	12992	585
spring 1989	1.110	126.9	5.72	3855	173.6	9719	438
TOTAL	3.457	594.4	26.77	13312	599.7	26995	1216

Table 1.5: Monthly summary of Discharge and Total Phosphorus, Potassium, and Chloride loadings to Rice Lake from the Indian River inflow, 1986-89. Loadings are in total kg and mg per m2 of watershed area.

Indian River

Month	Discharge	Total Phosphorus		Potassium		Chloride	
	(m3x10E6)	(kg)	(mg/m2)	(kg)	(mg/m2)	(kg)	(mg/m2)
8606	7.58	606	2.35	6973	27.0	45640	177
8607	4.79	179	0.69	4629	17.9	28970	112
8608	4.52	107	0.42	4377	17.0	26740	104
8609	6.59	86	0.33	8385	32.5	48830	189
8610	8.15	165	0.64	12990	50.3	65580	254
8611	6.30	69	0.27	8000	31.0	55240	214
8612	5.52	74	0.29	7289	28.3	57780	224
8701	4.38	39	0.15	5625	21.8	44920	174
8702	5.07	70	0.27	6953	26.9	50300	195
8703	10.83	304	1.18	18210	70.6	112300	435
8704	15.76	334	1.30	22670	87.9	134100	520
8705	4.85	113	0.44	4823	18.7	33780	131
8706	4.12	114	0.44	4316	16.7	25270	98
8707	5.89	280	1.08	7086	27.5	48890	189
8708	5.23	95	0.37	5065	19.6	34330	133
8709	5.17	68	0.26	4765	18.5	33900	131
8710	5.38	94	0.37	5682	22.0	40320	156
8711	4.85	56	0.22	6334	24.6	48030	186
8712	6.45	65	0.25	8818	34.2	67970	263
8801	5.29	138	0.53	8562	33.2	54680	212
8802	4.12	76	0.30	6267	24.3	45340	176
8803	8.15	394	1.53	15920	61.7	78790	305
8804	11.88	207	0.80	17470	67.7	107600	417
8805	6.88	154	0.60	7501	29.1	57120	221
8806	5.66	121	0.47	5212	20.2	41460	161
8807	6.47	122	0.47	6715	26.0	44230	171
8808	5.55	111	0.43	5475	21.2	38120	148
8809	6.46	83	0.32	5850	22.7	43870	170
8810	5.85	55	0.21	5053	19.6	46000	178
8811	5.72	69	0.27	5678	22.0	52620	204
8812	3.11	43	0.17	3756	14.6	44710	173
8901	3.67	104	0.40	5446	21.1	52060	202
8902	2.98	69	0.27	4583	17.8	45560	177
8903	9.33	906	3.51	25160	97.5	109000	422
8904	10.52	199	0.77	16280	63.1	111500	432
8905	10.28	141	0.55	12690	49.2	110200	427

Table 1.6: Seasonal and annual summary of Discharge and Total Phosphorus, Potassium, and Chloride loadings to Rice Lake from the Indian River inflow, 1986-89. Loadings are in total kg and mg per m2 of watershed area.

Indian River

	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
summer 1986	16.90	891	3.46	15979	61.9	101350	393
autumn 1986	21.04	320	1.24	29375	113.9	169650	658
winter 1987	14.97	183	0.71	19867	77.0	153000	593
spring 1987	31.44	751	2.91	45703	177.1	280180	1086
TOTAL	84.34	2145	8.31	110924	429.9	704180	2729
summer 1987	15.23	488	1.89	16467	63.8	108490	421
autumn 1987	15.39	218	0.85	16781	65.0	122250	474
winter 1988	15.86	280	1.08	23647	91.7	167990	651
spring 1988	26.92	756	2.93	40891	158.5	243510	944
TOTAL	73.41	1742	6.75	97786	379.0	642240	2489
summer 1988	17.68	354	1.37	17402	67.4	123810	480
autumn 1988	18.03	207	0.80	16581	64.3	142490	552
winter 1989	9.76	216	0.84	13785	53.4	142330	552
spring 1989	30.13	1245	4.83	54130	209.8	330700	1282
TOTAL	75.59	2022	7.84	101898	395.0	739330	2866

Table 1.7: Monthly summary of Discharge and Total Phosphorus, Potassium, and Chloride loadings to Rice Lake from the Ouse River inflow, 1986-89. Loadings are in total kg and mg per m2 of watershed area.

Ouse River

Month	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
8606	4.900	178	0.63	3137	11.1	34400	122
8607	2.780	106	0.38	2545	9.0	26050	92
8608	1.247	37	0.13	1345	4.8	13580	48
8609	1.583	37	0.13	1897	6.7	15420	55
8610	6.705	140	0.50	8282	29.4	59180	210
8611	4.352	46	0.16	4711	16.7	44300	157
8612	4.775	62	0.22	5249	18.6	54810	194
8701	5.990	48	0.17	6294	22.3	73860	262
8702	2.717	42	0.15	3088	11.0	37260	132
8703	6.826	210	0.74	10850	38.5	78930	280
8704	34.060	832	2.95	39480	140.0	292100	1036
8705	7.183	170	0.60	5717	20.3	63190	224
8706	2.821	95	0.34	2626	9.3	40390	143
8707	1.311	50	0.18	1756	6.2	17870	63
8708	0.421	23	0.08	783	2.8	10200	36
8709	0.306	8	0.03	626	2.2	7485	27
8710	0.680	12	0.04	1300	4.6	13250	47
8711	1.826	23	0.08	2739	9.7	26480	94
8712	6.126	102	0.36	8257	29.3	76610	272
8801	5.844	117	0.42	8338	29.6	99970	355
8802	5.293	159	0.56	5826	20.7	72210	256
8803	4.404	227	0.81	9696	34.4	54810	194
8804	25.130	829	2.94	28660	101.6	220500	782
8805	9.999	378	1.34	8841	31.4	86100	305
8806	3.945	155	0.55	4117	14.6	45760	162
8807	0.753	34	0.12	987	3.5	11940	42
8808	0.333	15	0.05	568	2.0	6355	23
8809	0.225	5	0.02	456	1.6	6071	22
8810	0.368	7	0.02	734	2.6	9595	34
8811	1.531	20	0.07	2188	7.8	28050	99
8812	1.580	14	0.05	2140	7.6	26870	95
8901	2.216	75	0.27	5738	20.3	51290	182
8902	2.699	76	0.27	3810	13.5	56130	199
8903	3.878	527	1.87	7025	24.9	54650	194
8904	15.800	383	1.36	19700	69.9	158000	560
8905	12.300	650	2.30	10470	37.1	129900	461

Table 1.8: Seasonal and annual summary of Discharge and Total Phosphorus, Potassium, and Chloride loadings to Rice Lake from the Ouse River inflow, 1986-89. Loadings are in total kg and mg per m2 of watershed area.

Ouse River

	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
summer 1986	8.927	320	1.14	7027	24.9	74030	263
autumn 1986	12.640	223	0.79	14890	52.8	118900	422
winter 1987	13.482	152	0.54	14631	51.9	165930	588
spring 1987	48.069	1212	4.30	56047	198.7	434220	1540
TOTAL	83.118	1907	6.76	92595	328.4	793080	2812
summer 1987	4.553	168	0.60	5165	18.3	68460	243
autumn 1987	2.812	44	0.16	4665	16.5	47215	167
winter 1988	17.263	378	1.34	22421	79.5	248790	882
spring 1988	39.533	1434	5.08	47197	167.4	361410	1282
TOTAL	64.161	2024	7.18	79448	281.7	725875	2574
summer 1988	5.031	204	0.72	5672	20.1	64055	227
autumn 1988	2.124	33	0.12	3378	12.0	43716	155
winter 1989	6.495	165	0.59	11688	41.4	134290	476
spring 1989	31.978	1559	5.53	37195	131.9	342550	1215
TOTAL	45.628	1961	6.95	57933	205.4	584611	2073

Table 1.9: Monthly summary of Discharge and Total Phosphorus, Potassium, and Chloride loadings to Rice Lake from the Otonabee River inflow, 1986-89. Loadings are in total kg and mg per m2 of watershed area.

Otonabee River

Month	Discharge	Total Phosphorus		Potassium		Chloride	
	(m3x10E6)	(kg)	(mg/m2)	(kg)	(mg/m2)	(kg)	(mg/m2)
8606	298.0	8029	1.05	292000	38.2	2239000	293
8607	166.1	5768	0.75	172700	22.6	1305000	171
8608	112.8	3469	0.45	108800	14.2	764400	100
8609	209.0	6178	0.81	192900	25.2	1437000	188
8610	561.6	10170	1.33	571900	74.7	3755001	491
8611	260.9	4806	0.63	291800	38.1	1910000	250
8612	259.3	3612	0.47	324900	42.5	2342000	306
8701	296.0	3170	0.41	360200	47.1	2575000	337
8702	245.6	3846	0.50	295500	38.6	2043000	267
8703	255.1	4345	0.57	384500	50.3	2738000	358
8704	537.0	13470	1.76	687100	89.8	4938001	645
8705	79.4	2515	0.33	102200	13.4	867000	113
8706	74.4	2693	0.35	91570	12.0	659400	86
8707	56.1	1770	0.23	65840	8.6	496100	65
8708	50.2	1672	0.22	55220	7.2	439700	57
8709	41.6	1359	0.18	47720	6.2	377600	49
8710	50.0	1081	0.14	59770	7.8	469700	61
8711	125.1	2178	0.28	137200	17.9	1171000	153
8712	256.7	3503	0.46	301700	39.4	2765001	361
8801	319.0	6216	0.81	413700	54.1	3533000	462
8802	298.3	7160	0.94	394100	51.5	3683001	481
8803	238.9	9417	1.23	387200	50.6	2516000	329
8804	427.4	8541	1.12	508500	66.5	3780001	494
8805	295.2	7568	0.99	351300	45.9	2669001	349
8806	120.3	4079	0.53	145600	19.0	1156000	151
8807	49.3	1994	0.26	59180	7.7	457000	60
8808	58.0	1922	0.25	61470	8.0	524900	69
8809	48.9	1300	0.17	51050	6.7	416200	54
8810	87.6	1827	0.24	86050	11.2	846900	111
8811	164.6	2449	0.32	161400	21.1	1482000	194
8812	225.2	3509	0.46	249900	32.7	2166000	283
8901	234.8	3424	0.45	244500	32.0	2847001	372
8902	176.9	5616	0.73	226100	29.6	2607001	341
8903	110.5	6945	0.91	184600	24.1	1587000	207
8904	425.3	8991	1.18	527400	68.9	4620000	604
8905	399.0	9931	1.30	494000	64.6	3864001	505

Table 1.10: Monthly summary of Discharge and Total Phosphorus, Potassium, and Chloride loadings to Rice Lake from the Otonabee River inflow, 1986-89. Loadings are in total kg and mg per m2 of watershed area.

Otonabee River

	Discharge	Total Phosphorus		Potassium		Chloride	
	(m3x10E6)	(kg)	(mg/m2)	(kg)	(mg/m2)	(kg)	(mg/m2)
summer 1986	577	17266	2.26	573500	75.0	4308400	563
autumn 1986	1032	21154	2.76	1056600	138.1	7102001	928
winter 1987	801	10628	1.39	980600	128.2	6960000	910
spring 1987	872	20330	2.66	1173800	153.4	8543001	1117
TOTAL	3281	69378	9.07	3784500	494.6	26913402	3518
summer 1987	181	6135	0.80	212630	27.8	1595200	208
autumn 1987	217	4618	0.60	244690	32.0	2018300	264
winter 1988	874	16879	2.21	1109500	145.0	9981002	1305
spring 1988	962	25526	3.34	1247000	163.0	8965002	1172
TOTAL	2233	53158	6.95	2813820	367.8	22559504	2949
summer 1988	228	7995	1.04	266250	34.8	2137900	279
autumn 1988	301	5576	0.73	298500	39.0	2745100	359
winter 1989	637	12549	1.64	720500	94.2	7620002	996
spring 1989	935	25867	3.38	1206000	157.6	10071001	1316
TOTAL	2100	51987	6.79	2491250	325.6	22574003	2950

Table 1.11: Monthly summary of Discharge and Total Phosphorus, Potassium, and Chloride loadings to Rice Lake through storage, 1986-89. Loadings are in total kg and mg per m2 of watershed area.

Storage

Month	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
8606	-9.09	-223.0	-2.23	0	0.0	-71956	-719
8607	-2.02	-46.4	-0.46	-2418	-24.2	-15698	-157
8608	-3.03	-105.7	-1.06	-3826	-38.2	-23663	-236
8609	7.07	308.3	3.08	8171	81.6	53609	536
8610	-13.13	-296.7	-2.96	-13299	-132.9	-89137	-890
8611	4.04	65.7	0.66	4077	40.7	27228	272
8612	-1.01	-16.4	-0.16	-1125	-11.2	-8339	-83
8701	-4.04	-38.4	-0.38	-4507	-45.0	-37544	-375
8702	3.03	18.8	0.19	3912	39.1	27859	278
8703	5.05	60.7	0.61	6712	67.1	49232	492
8704	6.06	119.3	1.19	6798	67.9	50573	505
8705	-1.01	-23.3	-0.23	-890	-8.9	-8029	-80
8706	-6.06	-110.4	-1.10	-5643	-56.4	-51456	-514
8707	0.00	0.0	0.00	0	0.0	0	0
8708	5.05	154.2	1.54	7269	72.6	50711	507
8709	-2.02	-93.1	-0.93	-2882	-28.8	-18916	-189
8710	-4.04	-123.3	-1.23	-5687	-56.8	-39007	-390
8711	0.00	0.0	0.00	0	0.0	0	0
8712	-3.03	-33.6	-0.34	-3429	-34.3	-29008	-290
8801	3.03	35.4	0.35	3664	36.6	30404	304
8802	0.00	0.0	0.00	0	0.0	0	0
8803	2.02	31.4	0.31	2627	26.2	21459	214
8804	10.10	223.3	2.23	11959	119.5	88045	880
8805	-5.05	-138.5	-1.38	-4483	-44.8	-40948	-409
8806	-4.04	-90.9	-0.91	-4031	-40.3	-37221	-372
8807	0.00	0.0	0.00	0	0.0	0	0
8808	2.02	55.7	0.56	3284	32.8	20258	202
8809	-1.01	-46.2	-0.46	-1669	-16.7	-10545	-105
8810	-7.07	-204.6	-2.04	-10428	-104.2	-71479	-714
8811	0.00	0.0	0.00	0	0.0	0	0
8812	0.00	0.0	0.00	0	0.0	0	0
8901	9.09	114.1	1.14	10751	107.4	101356	1013
8902	-3.03	-37.2	-0.37	-3725	-37.2	-37395	-374
8903	21.21	332.1	3.32	26866	268.4	258041	2578
8904	-11.11	-237.6	-2.37	-14772	-147.6	-104913	-1048
8905	-4.04	-99.0	-0.99	-4800	-48.0	-37709	-377

Table 1.12: Monthly summary of Discharge and Total Phosphorus, Potassium, and Chloride loadings to Rice Lake through storage, 1986-89. Loadings are in total kg and mg per m2 of watershed area.

Storage

	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
summer 1986	–14.14	–375.1	–3.75	–6244	–62.4	–111317	–1112
autumn 1986	–2.02	77.3	0.77	–1050	–10.5	–8300	–83
winter 1987	–2.02	–36.0	–0.36	–1719	–17.2	–18025	–180
spring 1987	10.10	156.7	1.57	12621	126.1	91776	917
TOTAL	–8.08	–177.1	–1.77	3607	36.0	–45865	–458
summer 1987	–1.01	43.8	0.44	1626	16.2	–745	–7
autumn 1987	–6.06	–216.4	–2.16	–8569	–85.6	–57923	–579
winter 1988	0.00	1.8	0.02	234	2.3	1396	14
spring 1988	7.07	116.1	1.16	10102	100.9	68557	685
TOTAL	0.00	–54.7	–0.55	3393	33.9	11285	113
summer 1988	–2.02	–35.2	–0.35	–747	–7.5	–16964	–169
autumn 1988	–8.08	–250.8	–2.51	–12096	–120.8	–82024	–819
winter 1989	6.06	76.9	0.77	7027	70.2	63960	639
spring 1989	6.06	–4.5	–0.04	7294	72.9	115418	1153
TOTAL	2.02	–213.7	–2.13	1477	14.8	80392	803

Table 1.13: Monthly summary of Discharge and Total Phosphorus, Potassium, and Chloride loadings to Rice Lake from precipitation, 1986-89. Loadings are in total kg and mg per m2 of watershed area.

Precip

Month	Discharge (m3*10e6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
8606	12.4	382	3.81	649	6.5	1792	17.9
8607	3.3	44	0.44	197	2.0	640	6.4
8608	10.6	82	0.82	1118	11.2	1383	13.8
8609	16.1	31	0.31	1406	14.0	643	6.4
8610	5.0	0	0.00	0	0.0	0	0.0
8611	3.8	104	104	10	0.1	346	3.5
8612	7.0	352	3.51	245	2.5	1682	16.8
8701	4.1	268	2.67	245	2.4	1958	19.6
8702	3.4	225	2.24	111	1.1	3509	35.1
8703	5.0	326	3.25	124	1.2	1913	19.1
8704	5.7	553	5.52	167	1.7	945	9.4
8705	4.4	442	4.41	140	1.4	374	3.7
8706	5.0	268	2.69	262	2.6	798	8.0
8707	7.8	1454	14.52	569	5.7	981	9.8
8708	8.5	1656	16.54	828	8.3	680	6.8
8709	6.9	146	1.46	345	3.4	448	18.9
8710	7.9	106	1.06	275	2.8	1888	17.3
8711	12.4	119	1.19	247	2.5	1731	17.8
8712	6.4	25	0.24	32	0.3	1779	17.7
8801	4.1	517	5.16	142	1.4	3979	39.8
8802	6.7	181	1.80	67	0.7	4613	46.1
8803	2.6	143	1.43	93	0.9	2038	20.4
8804	8.7	606	6.05	436	4.4	1745	17.4
8805	6.0	337	3.36	376	3.8	662	6.6
8806	3.3	638	6.37	483	4.8	425	4.3
8807	4.8	971	9.70	665	6.6	617	6.2
8808	4.9	179	1.78	195	1.9	366	3.7
8809	8.1	312	3.11	202	2.0	566	5.7
8810	9.4	109	1.08	188	1.9	1691	16.9
8811	6.9	54	0.54	35	0.3	1110	11.1
8812	6.0	46	0.46	120	1.2	4066	40.6
8901	3.7	631	6.30	202	2.0	4081	40.8
8902	2.5	285	2.84	102	1.0	2176	21.7
8903	5.9	160	1.60	238	2.4	4365	43.6
8904	4.4	85	0.85	99	1.0	1030	10.3
8905	9.5	146	1.45	213	2.1	993	9.9

Table 1.14: Monthly summary of Discharge and Total Phosphorus, Potassium, and Chloride loadings to Rice Lake from precipitation, 1986-89. Loadings are in total kg and mg per m2 of watershed area.

	Precip Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
summer 1986	26.3	508	5.08	1964	19.6	3817	38.1
autumn 1986	24.9	135	1.35	1416	14.1	989	9.9
winter 1987	14.5	844	8.43	601	6.0	7150	71.4
spring 1987	15.1	1321	13.19	431	4.3	3232	32.3
TOTAL	80.8	2808	28.0	4412	44.1	15188	151.7
summer 1987	21.3	3379	33.76	1659	16.6	2459	24.6
autumn 1987	27.1	372	3.71	868	8.7	4067	40.6
winter 1988	17.1	722	7.22	241	2.4	10371	103.6
spring 1988	17.4	1086	10.85	905	9.0	4445	44.4
TOTAL	82.9	5560	55.5	3672	36.7	21342	213.2
summer 1988	17.4	1788	17.86	1342	13.4	1408	14.1
autumn 1988	12.9	475	4.74	425	4.2	3367	33.6
winter 1989	24.4	963	9.62	424	4.2	10323	103.1
spring 1989	12.2	391	3.91	549	5.5	6388	63.8
TOTAL	66.9	3616	36.1	2740	27.4	21486	214.6

Table 1.15: Monthly summary of Discharge and Total Phosphorus, Potassium, and Chloride loadings to Rice Lake from the ungauged watershed, 1986-89. Loadings are in total kg and mg per m2 of watershed area.

Ungauged

Month	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
8606	5.62	367.8	1.49	4588	18.6	35768	144.6
8607	3.42	129.3	0.52	3256	13.2	24456	98.9
8608	2.65	69.9	0.28	2680	10.8	18175	73.5
8609	3.75	65.9	0.27	4787	19.4	29255	118.3
8610	6.64	141.1	0.57	9520	38.5	55618	224.9
8611	4.79	56.7	0.23	5765	23.3	44109	178.3
8612	4.70	71.3	0.29	5757	23.3	50517	204.2
8701	4.68	45.0	0.18	5378	21.7	52599	212.7
8702	3.52	53.8	0.22	4515	18.3	38676	156.4
8703	8.07	276.4	1.12	13574	54.9	86898	351.3
8704	22.02	532.3	2.15	27764	112.2	188503	762.1
8705	5.39	127.9	0.52	4758	19.2	42787	173.0
8706	3.15	97.1	0.39	3155	12.8	29009	117.3
8707	3.26	149.0	0.60	3975	16.1	29453	119.1
8708	2.56	54.8	0.22	2669	10.8	19794	80.0
8709	2.49	44.4	0.18	2586	10.5	18587	75.1
8710	2.76	51.7	0.21	3211	13.0	23943	96.8
8711	3.06	52.9	0.21	4210	17.0	33359	134.9
8712	5.65	89.0	0.36	7729	31.3	64054	259.0
8801	5.12	266.5	1.08	8295	33.5	68623	277.4
8802	4.30	134.9	0.55	5763	23.3	52962	214.1
8803	6.39	661.0	2.67	14734	59.6	63736	257.0
8804	16.31	460.2	1.86	20425	82.6	144294	583.0
8805	7.50	235.8	0.95	7276	29.4	62933	254.4
8806	4.30	127.0	0.51	4199	17.0	38407	155.3
8807	3.23	73.9	0.30	3456	14.0	24765	100.1
8808	2.67	59.4	0.24	2754	11.1	19777	80.0
8809	3.03	46.2	0.19	2902	11.7	22545	91.1
8810	2.83	31.0	0.13	2717	11.0	24849	100.5
8811	3.28	45.7	0.18	3616	14.6	35781	144.7
8812	2.19	31.6	0.13	2915	11.8	32046	129.6
8901	2.85	136.9	0.55	6080	24.6	47775	193.2
8902	2.84	190.4	0.77	5798	23.4	47381	191.6
8903	6.16	677.5	2.74	15491	62.6	75221	304.1
8904	11.58	258.3	1.04	15883	64.2	118385	478.6
8905	10.00	348.3	1.41	10322	41.7	105984	428.5

Table 1.16: Monthly summary of Discharge and Total Phosphorus, Potassium, and Chloride loadings to Rice Lake from the ungauged watershed, 1986-89. Loadings are in total kg and mg per m2 of watershed area.

Ungauged

	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
summer 1986	11.70	567.0	2.29	10524	43	78398	317
autumn 1986	15.19	263.7	1.07	20072	81	128983	521
winter 1987	12.91	170.0	0.69	15650	63	141792	573
spring 1987	35.48	936.7	3.79	46096	186	318188	1286
TOTAL	75.27	1937	7.83	92342	373	667361	2698
summer 1987	8.97	300.9	1.21	9799	40	78256	316
autumn 1987	8.31	149.0	0.60	10007	40	75888	307
winter 1988	15.07	490.4	1.98	21787	88	185639	751
spring 1988	30.21	1357.0	5.49	42437	172	270964	1096
TOTAL	62.56	2297	9.28	84030	340	610747	2469
summer 1988	10.20	260.3	1.05	10409	42	82950	335
autumn 1988	9.14	122.9	0.50	9235	37	83175	336
winter 1989	7.88	358.8	1.45	14794	60	127202	514
spring 1989	27.75	1284.2	5.19	41696	169	299591	1211
TOTAL	54.96	2026	8.19	76134	308	592918	2397

Table 1.17: Monthly summary of Discharge and Total Phosphorus, Potassium, and Chloride loadings from the outlet of Rice Lake (Trent River), 1986-89. Loadings are in total kg and mg per m2 of watershed area.

Trent River

Month	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
8606	252.2	6459	0.71	297600	32.6	1995000	219
8607	102.7	2484	0.27	123300	13.5	806100	88
8608	138.0	5021	0.55	175800	19.3	1093000	120
8609	329.6	12540	1.37	366800	40.2	2455001	269
8610	544.6	12930	1.42	558900	61.2	3762001	412
8611	219.5	4029	0.44	225300	24.7	1496000	164
8612	262.6	4434	0.49	292500	32.0	2174000	238
8701	302.8	2990	0.33	340700	37.3	2841001	311
8702	211.0	1305	0.14	274600	30.1	1958000	214
8703	290.2	3464	0.38	385300	42.2	2813001	308
8704	517.9	10580	1.16	598800	65.6	4492000	492
8705	75.0	1731	0.19	67340	7.4	597500	65
8706	81.5	1607	0.18	73610	8.1	689100	75
8707	61.9	1406	0.15	78970	8.6	570500	62
8708	51.8	1745	0.19	75090	8.2	522400	57
8709	69.5	3212	0.35	100300	11.0	658100	72
8710	82.4	2516	0.28	116800	12.8	807300	88
8711	159.7	3420	0.37	200700	22.0	1459000	160
8712	328.6	3460	0.38	380700	41.7	3259001	357
8801	306.4	3397	0.37	371300	40.7	3121001	342
8802	275.9	3563	0.39	371300	40.7	3013001	330
8803	247.0	3452	0.38	318800	34.9	2722000	298
8804	431.7	9990	1.09	503800	55.2	3742000	410
8805	269.7	7381	0.81	229600	25.1	2264001	248
8806	63.1	1444	0.16	61880	6.8	586900	64
8807	55.5	1082	0.12	79200	8.7	538600	59
8808	46.1	1279	0.14	76110	8.3	463600	51
8809	68.5	3040	0.33	114200	12.5	716600	78
8810	113.4	3275	0.36	173100	19.0	1148000	126
8811	242.1	3794	0.42	295500	32.4	2221001	243
8812	178.2	1774	0.19	195800	21.4	1623000	178
8901	244.6	3195	0.35	291300	31.9	2782001	305
8902	139.3	1668	0.18	169700	18.6	1666000	182
8903	183.6	3137	0.34	253700	27.8	2252001	247
8904	425.9	9227	1.01	578300	63.3	4075001	446
8905	420.6	10870	1.19	539200	59.1	4014001	440

Table 1.18: Monthly summary of Discharge and Total Phosphorus, Potassium, and Chloride loadings from the outlet of Rice Lake (Trent River), 1986-89. Loadings are in total kg and mg per m2 of watershed area.

Trent River

	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
summer 1986	492.900	13964	1.53	596700	65	3894100	427
autumn 1986	1093.700	29499	3.23	1151000	126	7713002	845
winter 1987	776.400	8729	0.96	907800	99	6973001	764
spring 1987	883.080	15775	1.73	1051440	115	7902501	866
TOTAL	3246.080	67967	7.44	3706941	406	26482604	2901
summer 1987	195.190	4758	0.52	227670	25	1782000	195
autumn 1987	311.580	9148	1.00	417800	46	2924400	320
winter 1988	910.900	10420	1.14	1123300	123	9393003	1029
spring 1988	948.400	20823	2.28	1052200	115	8728001	956
TOTAL	2366.070	45149	4.95	2820970	309	22827404	2500
summer 1988	164.700	3805	0.42	217190	24	1589100	174
autumn 1988	423.980	10109	1.11	582800	64	4085601	447
winter 1989	562.100	6637	0.73	656800	72	6071001	665
spring 1989	1030.100	23234	2.54	1371200	150	10341003	1133
TOTAL	2180.880	43785	4.80	2827990	310	22086705	2419

Table 1.19: Monthly summary of discharge and total phosphorus, potassium and chloride loadings to Sturgeon Lake from the Fenelon Falls inflow, 1986–89.

Fenelon Falls

Month	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
8606	1403.0	1524	0.47	102402	31.6	531400	164
8607	1106.0	896	0.28	78435	24.2	449400	138
8608	1094.0	887	0.27	79366	24.5	409100	126
8609	1425.0	1944	0.60	104688	32.3	522900	161
8610	2629.0	1947	0.60	223907	69.0	1031000	318
8611	1119.0	1241	0.38	93406	28.8	429600	132
8612	1066.0	1252	0.39	172574	53.2	393000	121
8701	986.9	629	0.19	108119	33.3	378800	117
8702	742.2	308	0.10	63891	19.7	276300	85
8703	912.4	679	0.21	81286	25.0	378200	117
8704	1897.0	2117	0.65	145616	44.9	737100	227
8705	637.3	570	0.18	52893	16.3	271900	84
8706	643.9	486	0.15	52930	16.3	273500	84
8707	662.4	348	0.11	51570	15.9	274900	85
8708	674.3	506	0.16	52626	16.2	282500	87
8709	579.5	504	0.16	45108	13.9	236800	73
8710	527.4	456	0.14	42926	13.2	208800	64
8711	653.1	562	0.17	56205	17.3	266300	82
8712	1294.0	1374	0.42	111271	34.3	540800	167
8801	1188.0	475	0.15	101052	31.1	487000	150
8802	1085.0	487	0.15	93479	28.8	443000	137
8803	851.9	543	0.17	74536	23.0	354200	109
8804	2911.0	2816	0.87	231852	71.4	1249000	385
8805	1488.0	1463	0.45	117556	36.2	606900	187
8806	753.1	670	0.21	61558	19.0	313800	97
8807	787.6	581	0.18	63624	19.6	328400	101
8808	648.2	372	0.11	49080	15.1	260100	80
8809	658.3	667	0.21	50657	15.6	264400	81
8810	625.1	603	0.19	48708	15.0	266000	82
8811	1177.0	948	0.29	96976	29.9	547400	169
8812	982.1	603	0.19	85704	26.4	439700	136
8901	928.0	571	0.18	74995	23.1	421300	130
8902	439.8	275	0.08	35047	10.8	222100	68
8903	721.0	521	0.16	57853	17.8	424300	131
8904	2502.0	2410	0.74	212418	65.5	1234000	380
8905	2383.0	2383	0.73	213053	65.7	1096000	338

Table 1.20: Seasonal ans annual summary of discharge and total phosphorus, potassium and chloride loadings to Sturgeon Lake from the Fenelon Falls inflow, 1986–89.

Fenelon Falls

	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
summer 1986	3603.0	3307	1.02	260203	80.2	1389900	428
autumn 1986	5173.0	5132	1.58	422001	130.0	1983500	611
winter 1987	2795.0	2189	0.67	344585	106.2	1048100	323
spring 1987	3447.0	3366	1.04	279795	86.2	1387200	427
TOTAL	15018.0	13994	4.31	1306584	402.6	5808700	1790
summer 1987	1981.0	1339	0.41	157125	48.4	830900	256
autumn 1987	1760.0	1522	0.47	144240	44.4	711900	219
winter 1988	3567.0	2336	0.72	305802	94.2	1470800	453
spring 1988	5251.0	4822	1.49	423945	130.6	2210101	681
TOTAL	12559.0	10019	3.09	1031112	317.8	5223701	1610
summer 1988	2189.0	1622	0.50	174262	53.7	902300	278
autumn 1988	2460.0	2218	0.68	196341	60.5	1077800	332
winter 1989	2350.0	1449	0.45	195747	60.3	1083100	334
spring 1989	5606.0	5314	1.64	483325	148.9	2754301	849
TOTAL	12605.0	10603	3.27	1049674	323.5	5817501	1793

Table 1.21: Monthly summary of discharge and total phosphorus, potassium and chloride loadings to Sturgeon Lake from the Emily Creek inflow, 1986-89.

Emily Creek

Month	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
8606	3.80	101.5	0.61	3840	23.0	33502	201
8607	0.64	15.2	0.09	499	3.0	5689	34
8608	0.48	9.3	0.06	135	0.8	5212	31
8609	3.63	49.2	0.29	5330	31.9	38163	229
8610	6.90	225.1	1.35	16021	95.9	91611	549
8611	2.50	41.0	0.25	4562	27.3	43804	262
8612	1.38	22.7	0.14	2359	14.1	21140	127
8701	1.00	16.5	0.10	1616	9.7	16171	97
8702	0.66	15.3	0.09	1146	6.9	12751	76
8703	16.83	355.0	2.13	28180	168.8	196457	1177
8704	11.37	167.3	1.00	17255	103.3	156504	937
8705	0.64	19.8	0.12	903	5.4	8508	51
8706	0.29	8.3	0.05	254	1.5	3704	22
8707	0.21	5.3	0.03	73	0.4	2200	13
8708	0.15	4.2	0.03	23	0.1	1367	8
8709	0.15	2.7	0.02	50	0.3	1384	8
8710	0.30	5.6	0.03	295	1.8	3621	22
8711	1.33	22.9	0.14	2062	12.4	19000	114
8712	5.43	70.5	0.42	10951	65.6	92914	556
8801	2.66	59.5	0.36	5556	33.3	47186	283
8802	4.26	73.7	0.44	7827	46.9	65631	393
8803	15.63	416.5	2.49	27338	163.7	213781	1280
8804	9.00	179.0	1.07	14452	86.6	105551	632
8805	3.51	111.8	0.67	4828	28.9	49117	294
8806	0.59	15.4	0.09	697	4.2	7421	44
8807	0.10	2.3	0.01	92	0.6	915	5
8808	0.15	2.4	0.01	101	0.6	2346	14
8809	0.25	5.6	0.03	426	2.6	9400	56
8810	0.31	4.4	0.03	359	2.2	6153	37
8811	2.11	25.6	0.15	2875	17.2	35990	216
8812	1.46	15.2	0.09	2609	15.6	37187	223
8901	1.44	19.8	0.12	3086	18.5	30938	185
8902	1.10	21.0	0.13	2882	17.3	36726	220
8903	12.13	809.6	4.85	29276	175.3	174264	1044
8904	12.54	296.2	1.77	26187	156.8	161792	969
8905	11.57	229.5	1.37	17120	102.5	195125	1169

Table 1.22: Seasonal and annual summary of discharge and total phosphorus, potassium and chloride loadings to Sturgeon Lake from the Emily Creek inflow, 1986–89.

Emily Creek

		Total Phosphorus		Potassium		Chloride	
		(kg)	(mg/m2)	(kg)	(mg/m2)	(kg)	(mg/m2)
summer 1986	4.93	126.0	0.75	4473	26.8	44403	266
autumn 1986	13.03	315.3	1.89	25913	155.2	173578	1040
winter 1987	3.04	54.5	0.33	5122	30.7	50062	300
spring 1987	28.84	542.1	3.25	46338	277.5	361468	2165
TOTAL	49.84	1037.8	6.22	81846	490.2	629511	3770
summer 1987	0.65	17.9	0.11	350	2.1	7271	44
autumn 1987	1.78	31.2	0.19	2408	14.4	24005	144
winter 1988	12.36	203.7	1.22	24334	145.7	205730	1232
spring 1988	28.14	707.3	4.24	46618	279.2	368448	2207
TOTAL	42.93	960.0	5.75	73710	441.5	605454	3626
summer 1988	0.84	20.2	0.12	890	5.3	10682	64
autumn 1988	2.68	35.6	0.21	3660	21.9	51543	309
winter 1989	4.00	56.0	0.34	8577	51.4	104850	628
spring 1989	36.24	1335.3	8.00	72582	434.7	531182	3181
TOTAL	43.75	1447.0	8.67	85709	513.3	698257	4182

Table 1.23: Monthly summary of discharge and total phosphorus, potassium and chloride loadings to Sturgeon Lake from the Hawkers Creek inflow, 1986-89.

Hawkers Creek

Month	Discharge	Total Phosphorus		Potassium		Chloride	
	(m3x10E6)	(kg)	(mg/m2)	(kg)	(mg/m2)	(kg)	(mg/m2)
8606	0.995	32.02	0.72	358	8.1	2515	57
8607	0.311	11.24	0.25	212	4.8	1632	37
8608	0.377	15.75	0.36	378	8.5	1820	41
8609	3.510	61.98	1.40	3927	88.6	11420	258
8610	3.726	19.90	0.45	4570	103.1	13940	314
8611	1.678	14.46	0.33	1713	38.6	6663	150
8612	1.443	14.60	0.33	1451	32.7	5678	128
8701	1.134	8.27	0.19	1103	24.9	5056	114
8702	1.139	13.82	0.31	1276	28.8	5235	118
8703	3.998	56.02	1.26	4336	97.8	13460	304
8704	4.157	45.06	1.02	3858	87.0	11470	259
8705	0.589	16.54	0.37	439	9.9	1879	42
8706	0.341	13.30	0.30	263	5.9	1205	27
8707	0.360	12.92	0.29	385	8.7	1408	32
8708	0.088	4.28	0.10	136	3.1	477	11
8709	0.080	3.28	0.07	140	3.1	522	12
8710	0.271	7.42	0.17	501	11.3	1876	42
8711	0.697	15.20	0.34	1278	28.8	3606	81
8712	2.279	25.14	0.57	2132	48.1	10270	232
8801	1.108	23.80	0.54	1599	36.1	5732	129
8802	0.868	10.57	0.24	897	20.2	4516	102
8803	2.148	50.25	1.13	2616	59.0	7965	180
8804	3.716	72.21	1.63	3943	89.0	12150	274
8805	1.356	37.69	0.85	940	21.2	5245	118
8806	0.227	9.52	0.21	129	2.9	1302	29
8807	0.084	2.89	0.07	79	1.8	649	15
8808	0.022	0.74	0.02	30	0.7	222	5
8809	0.089	2.15	0.05	121	2.7	893	20
8810	0.242	3.11	0.07	292	6.6	2178	49
8811	1.177	13.83	0.31	1034	23.3	7790	176
8812	0.957	7.44	0.17	800	18.1	6783	153
8901	1.030	8.23	0.19	866	19.5	8063	182
8902	0.654	5.94	0.13	540	12.2	5991	135
8903	2.899	122.60	2.77	4544	102.5	12330	278
8904	4.488	78.15	1.76	5150	116.2	17950	405
8905	4.428	60.42	1.36	2730	61.6	20680	467

Table 1.24 Seasonal and annual summary of discharge and total phosphorus, potassium and chloride loadings to Sturgeon Lake from the Hawkers Creek inflow, 1986-1989.

Hawkers Creek

	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
summer 1986	1.683	59.01	1.33	948	21.4	5967	135
autumn 1986	8.914	96.34	2.17	10209	230.3	32023	722
winter 1987	3.716	36.69	0.83	3831	86.4	15969	360
spring 1987	8.744	117.62	2.65	8633	194.7	26809	605
TOTAL	23.057	309.66	6.99	23621	532.8	80768	1822
summer 1987	0.790	30.50	0.69	784	17.7	3090	70
autumn 1987	1.048	25.90	0.58	1919	43.3	6004	135
winter 1988	4.255	59.51	1.34	4628	104.4	20518	463
spring 1988	7.220	160.15	3.61	7499	169.2	25360	572
TOTAL	13.312	276.07	6.23	14830	334.5	54972	1240
summer 1988	0.333	13.16	0.30	238	5.4	2173	49
autumn 1988	1.508	19.09	0.43	1447	32.6	10861	245
winter 1989	2.642	21.61	0.49	2206	49.8	20837	470
spring 1989	11.820	261.17	5.89	12424	280.3	50960	1150
TOTAL	16.302	315.03	7.11	16315	368.0	84830	1914

Table 1.25: Monthly summary of discharge and total phosphorus, potassium and chloride loadings to Sturgeon Lake from the McLaren Creek inflow, 1986-89.

McLaren Creek

Month	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
8606	1.774	61.4	1.15	1774	33.2	20680	387
8607	0.364	12.5	0.23	557	10.4	5623	105
8608	0.555	21.3	0.40	1210	22.7	8529	160
8609	3.206	98.4	1.84	8146	152.6	37630	705
8610	3.668	27.7	0.52	7842	146.9	46590	873
8611	1.248	21.7	0.41	2963	55.5	19270	361
8612	0.956	12.1	0.23	1373	25.7	16740	314
8701	0.982	19.5	0.37	1683	31.5	17810	334
8702	1.081	15.7	0.29	2046	38.3	22020	412
8703	7.109	138.1	2.59	16298	305.3	104200	1952
8704	3.529	44.3	0.83	5782	108.3	41880	784
8705	0.448	13.5	0.25	652	12.2	6630	124
8706	0.100	6.0	0.11	148	2.8	1659	31
8707	0.013	0.8	0.02	37	0.7	316	6
8708	0.000	0.0	0.00	0	0.0	0	0
8709	0.000	0.0	0.00	0	0.0	0	0
8710	0.069	1.7	0.03	200	3.7	1635	31
8711	0.580	11.9	0.22	1292	24.2	11930	223
8712	2.323	44.4	0.83	4510	84.5	45130	845
8801	1.709	68.5	1.28	4368	81.8	32750	613
8802	2.025	52.2	0.98	3811	71.4	38380	719
8803	3.481	172.3	3.23	6958	130.3	48520	909
8804	2.485	49.0	0.92	3934	73.7	33710	631
8805	1.247	46.6	0.87	1823	34.1	17530	328
8806	0.132	3.7	0.07	132	2.5	2123	40
8807	0.000	0.0	0.00	0	0.0	0	0
8808	0.007	0.2	0.00	15	0.3	288	5
8809	0.054	1.1	0.02	137	2.6	1876	35
8810	0.393	4.3	0.08	917	17.2	11170	209
8811	1.858	11.5	0.22	3382	63.3	35130	658
8812	1.346	24.7	0.46	2240	42.0	28820	540
8901	1.459	48.6	0.91	2849	53.4	37380	700
8902	0.822	12.9	0.24	1678	31.4	26160	490
8903	2.109	67.4	1.26	4166	78.0	51460	964
8904	2.030	29.7	0.56	3714	69.6	33160	621
8905	2.386	37.2	0.70	3891	72.9	39430	739

Table 1.26 : Seasonal and annual summary of discharge, and total phosphorus potassium and chloride loadings to Sturgeon Lake from the McLaren Creek inflow. 1986 – 1989.

McLaren Creek

	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
summer 1986	2.693	95.2	1.78	3542	66.3	34832	652
autumn 1986	8.122	147.8	2.77	18951	355.0	103490	1938
winter 1987	3.019	47.4	0.89	5101	95.5	56570	1060
spring 1987	11.090	195.9	3.67	22732	425.8	152710	2860
TOTAL	24.924	486.3	9.11	50326	942.6	347602	6511
summer 1987	0.113	6.9	0.13	185	3.5	1975	37
autumn 1987	0.649	13.7	0.26	1492	28.0	13565	254
winter 1988	6.057	165.1	3.09	12688	237.7	116260	2178
spring 1988	7.213	267.9	5.02	12714	238.1	99760	1869
TOTAL	14.033	453.6	8.50	27080	507.2	231560	4337
summer 1988	0.139	3.9	0.07	147	2.7	2411	45
autumn 1988	2.304	16.8	0.32	4436	83.1	48176	902
winter 1989	3.627	86.2	1.62	6767	126.7	92360	1730
spring 1989	6.525	134.3	2.52	11772	220.5	124050	2323
TOTAL	12.595	241.3	4.52	23121	433.1	266997	5001

Table 1.27: Monthly summary of discharge and total phosphorus, potassium and chloride loadings to Sturgeon Lake from the Martin Creek inflow, 1986–89.

Martin Creek

Month	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
8606	0.927	35.76	1.03	482	13.9	5396	155
8607	0.222	11.70	0.34	164	4.7	1490	43
8608	0.311	15.92	0.46	345	9.9	2032	59
8609	2.276	52.69	1.52	2164	62.3	12750	367
8610	2.705	24.04	0.69	3162	91.0	18460	532
8611	1.279	12.89	0.37	1102	31.7	9351	269
8612	0.767	10.61	0.31	542	15.6	5658	163
8701	0.676	9.10	0.26	422	12.1	5334	154
8702	0.638	10.26	0.30	535	15.4	4963	143
8703	3.077	81.35	2.34	3542	102.0	19280	555
8704	3.456	42.77	1.23	3156	90.9	21210	611
8705	0.742	14.04	0.40	564	16.2	4695	135
8706	0.345	14.67	0.42	271	7.8	2190	63
8707	0.256	9.83	0.28	224	6.5	1553	45
8708	0.125	5.12	0.15	112	3.2	861	25
8709	0.082	3.32	0.10	108	3.1	592	17
8710	0.176	2.59	0.07	195	5.6	1448	42
8711	0.486	8.58	0.25	454	13.1	4110	118
8712	0.594	8.56	0.25	480	13.8	4521	130
8801	1.004	36.44	1.05	1212	34.9	9528	274
8802	0.872	34.97	1.01	805	23.2	8327	240
8803	1.297	76.81	2.21	1561	44.9	9830	283
8804	2.207	38.11	1.10	2020	58.2	16760	483
8805	1.354	36.78	1.06	1081	31.1	10040	289
8806	0.467	14.96	0.43	273	7.9	4348	125
8807	0.113	6.53	0.19	60	1.7	1030	30
8808	0.073	1.77	0.05	46	1.3	666	19
8809	0.241	5.65	0.16	178	5.1	2245	65
8810	0.362	2.60	0.07	300	8.6	4440	128
8811	1.039	6.24	0.18	777	22.4	11100	320
8812	0.924	11.09	0.32	657	18.9	14110	406
8901	0.719	6.93	0.20	509	14.6	10860	313
8902	0.637	8.68	0.25	437	12.6	11290	325
8903	2.361	160.10	4.61	3408	98.1	27330	787
8904	2.526	50.24	1.45	2521	72.6	25280	728
8905	2.746	43.34	1.25	2012	57.9	23050	664

Table 1.28: Seasonal and annual summary of discharge and total phosphorus, potassium and chloride loadings to Sturgeon Lake from the Martin Creek inflow, 1986–89.

Martin Creek

	Discharge	Total Phosphorus		Potassium		Chloride	
	(m3x10E6)	(kg)	(mg/m2)	(kg)	(mg/m2)	(kg)	(mg/m2)
summer 1986	1.460	63.38	1.82	990	28.5	8918	257
autumn 1986	6.260	89.62	2.58	6428	185.1	40561	1168
winter 1987	2.081	29.97	0.86	1499	43.2	15955	459
spring 1987	7.275	138.16	3.98	7262	209.1	45185	1301
TOTAL	17.076	321.13	9.25	16179	465.9	110619	3185
summer 1987	0.727	29.62	0.85	607	17.5	4604	133
autumn 1987	0.744	14.48	0.42	757	21.8	6150	177
winter 1988	2.470	79.97	2.30	2497	71.9	22376	644
spring 1988	4.858	151.70	4.37	4662	134.2	36630	1055
TOTAL	8.798	275.77	7.94	8523	245.4	69760	2009
summer 1988	0.653	23.26	0.67	379	10.9	6044	174
autumn 1988	1.642	14.49	0.42	1255	36.1	17785	512
winter 1989	2.280	26.70	0.77	1603	46.1	36260	1044
spring 1989	7.633	253.68	7.30	7941	228.6	75660	2179
TOTAL	12.208	318.13	9.16	11177	321.8	135749	3909

Table 1.29: Monthly summary of discharge and total phosphorus, potassium and chloride loadings to Sturgeon Lake from the Rutherford Creek inflow, 1986–89.

Rutherford Creek

Month	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
8606	0.378	17.0	0.93	973	53.4	3348	184
8607	0.074	2.4	0.13	93	5.1	1076	59
8608	0.046	1.0	0.05	74	4.0	761	42
8609	0.582	10.3	0.57	964	52.9	3189	175
8610	0.510	4.6	0.25	1031	56.5	3154	173
8611	0.232	2.7	0.15	334	18.3	1874	103
8612	0.242	3.9	0.22	353	19.4	2247	123
8701	0.145	1.4	0.08	198	10.9	1487	82
8702	0.061	0.9	0.05	97	5.3	746	41
8703	0.852	18.5	1.01	1298	71.2	6059	332
8704	0.584	8.8	0.49	794	43.6	3548	195
8705	0.072	1.3	0.07	85	4.7	575	32
8706	0.009	0.2	0.01	13	0.7	114	6
8707	0.006	0.6	0.03	23	1.3	107	6
8708	0.000	0.0	0.00	1	0.1	8	0
8709	0.003	0.1	0.00	6	0.3	57	3
8710	0.014	0.2	0.01	34	1.9	282	15
8711	0.091	1.7	0.09	187	10.2	1511	83
8712	0.363	5.0	0.28	447	24.5	3498	192
8801	0.242	9.2	0.51	424	23.2	2932	161
8802	0.232	7.9	0.43	351	19.3	2191	120
8803	0.632	34.3	1.88	989	54.3	4918	270
8804	0.588	16.4	0.90	766	42.0	3681	202
8805	0.318	4.8	0.26	314	17.2	2742	150
8806	0.094	1.5	0.08	124	6.8	1887	104
8807	0.048	1.2	0.07	107	5.9	1364	75
8808	0.043	0.9	0.05	85	4.7	1313	72
8809	0.023	1.0	0.06	34	1.9	513	28
8810	0.012	0.2	0.01	21	1.1	315	17
8811	0.140	1.3	0.07	174	9.5	1908	105
8812	0.139	1.6	0.09	199	10.9	2327	128
8901	0.154	1.7	0.09	205	11.2	3066	168
8902	0.040	0.6	0.03	49	2.7	909	50
8903	0.547	39.8	2.18	906	49.7	5175	284
8904	0.594	14.2	0.78	740	40.6	4274	234
8905	0.601	6.8	0.37	443	24.3	4703	258

Table 1.30: Seasonal and annual summary of discharge and total phosphorus, potassium and chloride loadings to Sturgeon Lake from the Rutherford Creek inflow, 1986–89.

Rutherford Creek

	Discharge	Total Phosphorus		Potassium		Chloride	
	(m3x10E6)	(kg)	(mg/m2)	(kg)	(mg/m2)	(kg)	(mg/m2)
summer 1986	0.497	20.4	1.12	1140	62.5	5185	284
autumn 1986	1.323	17.7	0.97	2329	127.7	8217	451
winter 1987	0.448	6.2	0.34	648	35.6	4480	246
spring 1987	1.508	28.6	1.57	2177	119.4	10182	559
TOTAL	3.777	72.9	4.00	6294	345.3	28064	1539
summer 1987	0.015	0.8	0.05	37	2.1	229	13
autumn 1987	0.108	1.9	0.11	227	12.5	1850	101
winter 1988	0.837	22.1	1.21	1222	67.0	8621	473
spring 1988	1.539	55.5	3.04	2070	113.5	11341	622
TOTAL	2.499	80.4	4.41	3556	195.1	22040	1209
summer 1988	0.186	3.7	0.20	316	17.3	4564	250
autumn 1988	0.175	2.5	0.14	229	12.5	2736	150
winter 1989	0.333	3.9	0.21	453	24.9	6302	346
spring 1989	1.743	60.8	3.33	2088	114.5	14152	776
TOTAL	2.437	70.8	3.89	3086	169.3	27753	1522

Table 1.31: Monthly summary of discharge and total phosphorus, potassium and chloride loadings to Sturgeon Lake from the Scugog River inflow, 1986–89.

Scugog River

Month	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
8606	13.29	713	0.74	26578	27.6	242288	251
8607	8.24	557	0.58	16601	17.2	153642	159
8608	18.34	894	0.93	33385	34.6	266723	277
8609	29.57	1256	1.30	76311	79.2	491640	510
8610	54.32	1476	1.53	128803	133.7	858784	891
8611	14.19	308	0.32	30785	31.9	248672	258
8612	22.10	420	0.44	42220	43.8	488511	507
8701	28.70	260	0.27	64401	66.8	587382	610
8702	11.98	80	0.08	28188	29.2	231292	240
8703	41.59	1136	1.18	86820	90.1	614445	638
8704	48.93	1732	1.80	98892	102.6	868442	901
8705	2.67	147	0.15	5321	5.5	47268	49
8706	3.75	176	0.18	5673	5.9	58914	61
8707	8.97	429	0.45	17724	18.4	137293	142
8708	4.19	214	0.22	8700	9.0	68384	71
8709	2.62	182	0.19	5659	5.9	45918	48
8710	6.60	235	0.24	14289	14.8	139948	145
8711	33.26	985	1.02	73585	76.4	1059543	1099
8712	44.73	1075	1.12	120426	125.0	1235213	1282
8801	21.28	319	0.33	51359	53.3	518915	538
8802	23.85	358	0.37	55801	57.9	481697	500
8803	15.60	500	0.52	36959	38.4	301999	313
8804	28.75	972	1.01	59734	62.0	476103	494
8805	11.80	913	0.95	20349	21.1	213092	221
8806	1.94	218	0.23	3888	4.0	44660	46
8807	2.20	108	0.11	3373	3.5	44370	46
8808	2.01	96	0.10	4115	4.3	42263	44
8809	1.70	74	0.08	3558	3.7	37462	39
8810	1.39	104	0.11	3278	3.4	32795	34
8811	21.77	1850	1.92	52851	54.8	494355	513
8812	8.34	277	0.29	19201	19.9	218536	227
8901	13.76	385	0.40	35505	36.8	385330	400
8902	10.32	198	0.21	25713	26.7	288949	300
8903	18.05	1924	2.00	79642	82.6	489332	508
8904	20.30	633	0.66	46277	48.0	395938	411
8905	30.84	721	0.75	53260	55.3	670091	695

Table 1.32: Seasonal and annual summary of discharge and total phosphorus, potassium and chloride loadings to Sturgeon Lake from the Scugog River inflow, 1986–89.

Scugog River

	Discharge	Total Phosphorus		Potassium		Chloride	
	(m3x10E6)	(kg)	(mg/m2)	(kg)	(mg/m2)	(kg)	(mg/m2)
summer 1986	39.87	2163	2.24	76565	79.4	662653	688
autumn 1986	98.08	3039	3.15	235900	244.8	1599097	1659
winter 1987	62.78	760	0.79	134809	139.9	1307185	1356
spring 1987	93.19	3015	3.13	191034	198.2	1530156	1588
TOTAL	293.92	8977	9.32	638307	662.4	5099091	5291
summer 1987	16.92	820	0.85	32098	33.3	264592	275
autumn 1987	42.48	1401	1.45	93532	97.1	1245408	1292
winter 1988	89.86	1752	1.82	227585	236.2	2235826	2320
spring 1988	56.15	2385	2.47	117041	121.5	991194	1029
TOTAL	205.41	6358	6.60	470257	488.0	4737020	4915
summer 1988	6.15	422	0.44	11376	11.8	131293	136
autumn 1988	24.86	2028	2.10	59687	61.9	564612	586
winter 1989	32.42	860	0.89	80420	83.4	892815	926
spring 1989	69.19	3279	3.40	179179	185.9	1555361	1614
TOTAL	132.62	6588	6.84	330662	343.1	3144081	3263

Table 1.33: Monthly summary of discharge and total phosphorus, potassium and chloride loadings to Sturgeon Lake from storage, 1986-89.

Storage

Month	Discharge (m3x10E6)	Total Phosphorus (kg)	Potassium (kg)	Chloride (kg)
8606	-1.884	-34.4	-2127	-12249
8607	0.471	5.2	434	3064
8608	-1.884	-28.3	-2469	-10364
8609	2.355	35.8	2091	14178
8610	-4.239	-75.2	-5362	-30573
8611	0.471	4.9	549	3083
8612	4.710	55.0	5385	32344
8701	-14.600	-109.5	-13871	-77020
8702	-8.949	-42.5	-9106	-53807
8703	14.130	222.0	19510	138021
8704	5.652	63.9	6935	53174
8705	3.297	40.2	3857	25911
8706	-1.413	-26.8	-1606	-10538
8707	0.000	0.0	0	0
8708	-0.471	-6.7	-494	-3295
8709	0.000	0.0	0	0
8710	-0.471	-6.4	-470	-3325
8711	0.941	10.4	940	6666
8712	-1.413	-15.1	-1550	-10927
8801	-7.065	-59.3	-6810	-48217
8802	-6.594	-52.8	-7201	-45762
8803	8.949	74.6	10575	69356
8804	6.123	79.6	7372	58164
8805	0.000	0.0	0	0
8806	-0.471	-7.8	-527	-3380
8807	1.413	22.9	1376	8986
8808	-1.413	-18.8	-1335	-8548
8809	0.000	0.0	0	0
8810	-1.413	-23.5	-1210	-8666
8811	-1.413	-12.0	-1275	-9255
8812	1.884	18.8	2020	17047
8901	-10.360	-76.7	-10113	-74866
8902	-6.123	-31.8	-5914	-41878
8903	23.550	164.9	25481	200175
8904	-4.240	-72.9	-5774	-44515
8905	-1.413	-20.9	-1542	-12999

Table 1.34: Seasonal and annual summary of discharge and total phosphorus, potassium and chloride loadings to Sturgeon Lake from storage, 1986–89.

Storage

	Discharge (m3x10E6)	Total Phosphorus (kg)	Potassium (kg)	Chloride (kg)
summer 1986	–3.297	–57.5	–4162	–19548
autumn 1986	–1.413	–34.6	–2722	–13311
winter 1987	–18.840	–97.1	–17591	–98482
spring 1987	23.080	326.1	30301	217106
TOTAL	–0.470	137.0	5826	85765
summer 1987	–1.884	–33.6	–2100	–13833
autumn 1987	0.471	4.0	470	3341
winter 1988	–14.600	–127.2	–15561	–104906
spring 1988	15.070	154.2	17946	127520
TOTAL	–0.943	–2.6	756	12122
summer 1988	–0.471	–3.8	–486	–2942
autumn 1988	–2.826	–35.6	–2486	–17921
winter 1989	–14.600	–89.7	–14007	–99696
spring 1989	17.900	71.0	18164	142661
TOTAL	0.003	–58.0	1185	22101

Table 1.35: Monthly summary of discharge and total phosphorus, potassium and chloride loadings to Sturgeon Lake from precipitation, 1986–89.

Precip

Month	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
8606	6.773	209	4.44	356	7.5	982	21
8607	2.355	32	0.68	141	3.0	459	10
8608	4.776	37	0.78	501	10.6	621	13
8609	8.403	16	0.34	735	15.6	336	7
8610	1.988	0	0.00	0	0.0	0	0
8611	1.677	45	0.96	4	0.1	151	3
8612	2.873	144	3.06	101	2.1	690	15
8701	2.336	153	3.25	140	3.0	1121	24
8702	1.319	87	1.84	43	0.9	1352	29
8703	2.986	196	4.16	75	1.6	1150	24
8704	2.294	221	4.70	2609	55.4	1755	37
8705	1.780	179	4	2070	43.9	1353	29
8706	3.231	175	3.71	170	3.6	517	11
8707	4.578	848	18.01	332	7.0	572	12
8708	3.372	657	13.96	329	7.0	270	6
8709	3.288	70	1.48	164	3.5	214	5
8710	3.391	46	0.97	119	2.5	814	17
8711	4.927	48	1.01	99	2.1	690	15
8712	2.473	10	0.20	12	0.3	692	15
8801	2.699	344	7.30	94	2.0	2645	56
8802	3.787	102	2.17	38	0.8	2613	55
8803	1.229	66	1.41	43	0.9	947	20
8804	3.240	225	4.78	162	3.4	648	14
8805	3.250	182	3.86	203	4.3	357	8
8806	2.190	427	9.06	323	6.9	285	6
8807	3.019	618	13.11	423	9.0	392	8
8808	4.159	153	3.24	166	3.5	312	7
8809	5.035	194	4.13	126	2.7	352	7
8810	4.522	52	1.11	90	1.9	814	17
8811	4.135	32	0.68	21	0.4	662	14
8812	4.154	32	0.68	83	1.8	2825	60
8901	2.515	432	9.17	138	2.9	2792	59
8902	1.583	177	3.76	63	1.3	1353	29
8903	1.818	49	1.04	73	1.5	1336	28
8904	2.157	42	0.88	49	1.0	507	11
8905	4.409	68	1.45	99	2.1	463	10

Table 1.36: Seasonal and annual summary of discharge and total phosphorus, potassium and chloride loadings to Sturgeon Lake from precipitation, 1986–89.

Precip

	Discharge	Total Phosphorus		Potassium		Chloride	
	(m3x10E6)	(kg)	(mg/m2)	(kg)	(mg/m2)	(kg)	(mg/m2)
summer 1986	13.900	227	5.90	998	21.2	2062	44
autumn 1986	12.070	62	1.31	739	15.7	487	10
winter 1987	6.528	384	8.15	284	6.0	3163	67
spring 1987	7.060	596	12.65	4754	100.9	4257	90
TOTAL	39.558	1319	28.01	6775	143.8	9969	212
summer 1987	11.180	1680	35.67	830	17.6	1359	29
autumn 1987	11.610	163	3.46	382	8.1	1717	36
winter 1988	8.958	456	9.67	145	3.1	5950	126
spring 1988	7.720	473	10.05	408	8.7	1952	41
TOTAL	39.468	2772	58.86	1765	37.5	10979	233
summer 1988	9.368	1197	25.42	912	19.4	989	21
autumn 1988	13.690	279	5.92	237	5.0	1828	39
winter 1989	8.252	641	13.61	285	6.0	6970	148
spring 1989	8.384	159	3.37	220	4.7	2306	49
TOTAL	39.694	2276	48.32	1654	35.1	12093	257

Table 1.37: Monthly summary of discharge and total phosphorus, potassium and chloride loadings to Sturgeon Lake from the unguaged watershed, 1986–89.

Ungauged

Month	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
8606	4.937	183.4	0.96	3900	20.5	96083	505
8607	1.098	45.0	0.24	1281	6.7	24914	131
8608	1.351	62.9	0.33	2450	12.9	31662	166
8609	10.050	264.2	1.39	18308	96.2	162167	852
8610	11.980	107.5	0.56	21621	113.6	224431	1179
8611	4.896	61.9	0.33	7584	39.8	97066	510
8612	3.603	51.8	0.27	4761	25.0	79885	420
8701	3.050	45.2	0.24	4183	22.0	74611	392
8702	2.932	47.0	0.25	4606	24.2	77302	406
8703	19.040	418.2	2.20	33192	174.4	404978	2128
8704	14.340	192.8	1.01	18181	95.5	232477	1222
8705	1.924	51.7	0.27	2093	11.0	34441	181
8706	0.830	37.9	0.20	788	4.1	12192	64
8707	0.659	27.5	0.14	824	4.3	9845	52
8708	0.245	10.6	0.06	309	1.6	4321	23
8709	0.197	7.5	0.04	300	1.6	3697	19
8710	0.585	13.2	0.07	1054	5.5	13252	70
8711	2.130	41.4	0.22	3694	19.4	51636	271
8712	6.808	108.4	0.57	9846	51.7	166606	875
8801	4.594	157.1	0.83	8935	46.9	123339	648
8802	4.999	123.2	0.65	7063	37.1	130747	687
8803	11.670	420.2	2.21	15296	80.4	199687	1049
8804	11.080	239.5	1.26	14569	76.6	208078	1093
8805	5.039	143.9	0.76	5043	26.5	94309	496
8806	1.036	33.9	0.18	827	4.3	25583	134
8807	0.259	12.0	0.06	281	1.5	6993	37
8808	0.179	5.9	0.03	191	1.0	8173	43
8809	0.457	11.3	0.06	664	3.5	19259	101
8810	1.039	11.8	0.06	1794	9.4	43778	230
8811	4.572	41.6	0.22	6632	34.8	150677	792
8812	3.586	52.3	0.27	4798	25.2	136164	715
8901	3.577	76.9	0.40	5255	27.6	152026	799
8902	2.343	33.2	0.17	3221	16.9	114662	602
8903	10.980	548.0	2.88	19492	102.4	303393	1594
8904	12.720	241.4	1.27	18024	94.7	277281	1457
8905	12.920	202.3	1.06	13036	68.5	305303	1604

Table 1.38: Seasonal and annual summary of discharge and total phosphorus, potassium and chloride loadings to Sturgeon Lake from the unguaged watershed, 1986–89.

Ungauged

	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
summer 1986	7.387	291.3	1.53	7631	40.1	152659	802
autumn 1986	25.800	433.6	2.28	47512	249.6	483664	2541
winter 1987	9.530	144.0	0.76	13550	71.2	231798	1218
spring 1987	33.280	662.8	3.48	53466	280.9	671895	3530
TOTAL	75.997	1531.7	8.05	122160	641.9	1540015	8092
summer 1987	2.056	75.9	0.40	1921	10.1	26358	138
autumn 1987	2.695	62.0	0.33	5048	26.5	68585	360
winter 1988	14.120	388.6	2.04	25845	135.8	420692	2210
spring 1988	25.730	803.6	4.22	34908	183.4	502075	2638
TOTAL	44.600	1330.3	6.99	67721	355.8	1017710	5347
summer 1988	1.819	51.8	0.27	1299	6.8	40749	214
autumn 1988	9.109	64.7	0.34	9091	47.8	213714	1123
winter 1989	13.560	162.4	0.85	13275	69.8	402852	2117
spring 1989	36.630	991.6	5.21	50552	265.6	885978	4655
TOTAL	61.117	1270.5	6.68	74217	390.0	1543293	8109

Table 1.39: Monthly summary of discharge and total phosphorus, potassium and chloride loadings from the outlet of Sturgeon Lake (Big Bob Channel), 1986–89.

Big Bob Channel

Month	Discharge (m3x10E6)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
8606	157.2	3247	0.68	146200	30.7	1001000	210
8607	94.7	1348	0.28	87530	18.4	606400	127
8608	114.4	1886	0.40	132900	27.9	636400	134
8609	214.1	2701	0.57	191400	40.2	1296000	272
8610	363.2	6099	1.28	444700	93.4	2611000	548
8611	145.9	1505	0.32	170700	35.8	953000	200
8612	146.6	1801	0.38	164500	34.5	1005000	211
8701	161.2	1276	0.27	154600	32.5	872800	183
8702	116.1	564	0.12	118500	24.9	698500	147
8703	220.2	4341	0.91	295500	62.0	2070000	435
8704	337.4	3905	0.82	413000	86.7	3111000	653
8705	63.8	766	0.16	74650	15.7	500500	105
8706	61.1	1183	0.25	69600	14.6	457800	96
8707	62.7	801	0.17	67440	14.2	436100	92
8708	47.5	779	0.16	50040	10.5	331800	70
8709	42.9	1091	0.23	44600	9.4	306100	64
8710	48.1	661	0.14	48290	10.1	344200	72
8711	94.3	1023	0.22	93860	19.7	664900	140
8712	198.3	1995	0.42	220100	46.2	1562000	328
8801	165.2	1425	0.30	161500	33.9	1111000	233
8802	164.5	1309	0.28	180000	37.8	1142000	240
8803	138.0	1088	0.23	164300	34.5	1090000	229
8804	372.4	4820	1.01	448300	94.1	3526001	740
8805	184.2	1989	0.42	184300	38.7	1261000	265
8806	50.8	775	0.16	55730	11.7	360800	76
8807	54.1	939	0.20	53070	11.1	343900	72
8808	50.5	707	0.15	47900	10.1	305600	64
8809	64.0	1145	0.24	57880	12.2	394400	83
8810	46.8	789	0.17	40790	8.6	281500	59
8811	125.6	966	0.20	115300	24.2	851800	179
8812	104.6	999	0.21	111600	23.4	924800	194
8901	104.3	789	0.17	103000	21.6	766400	161
8902	48.3	263	0.06	45840	9.6	315100	66
8903	93.0	796	0.17	110000	23.1	811300	170
8904	357.4	6896	1.45	527300	110.7	3934001	826
8905	339.6	4653	0.98	367200	77.1	3126001	656

Table 1.40: Seasonal and annual summary of discharge and total phosphorus, potassium and chloride loadings from the outlet of Sturgeon Lake (Big Bob Channel), 1986–89.

Big Bob Channel

	Discharge	Total Phosphorus		Potassium		Chloride	
	(m3x10E6)	(kg)	(mg/m2)	(kg)	(mg/m2)	(kg)	(mg/m2)
summer 1986	366.3	6481	1.36	366630	77.0	2243800	471
autumn 1986	723.2	10305	2.16	806800	169.4	4860000	1020
winter 1987	423.9	3641	0.76	437600	91.9	2576301	541
spring 1987	621.4	9012	1.89	783150	164.4	5681501	1193
TOTAL	2134.8	29438	6.18	2394180	502.6	15361602	3225
summer 1987	171.3	2762	0.58	187080	39.3	1225700	257
autumn 1987	185.3	2775	0.58	186750	39.2	1315200	276
winter 1988	528.0	4729	0.99	561600	117.9	3815001	801
spring 1988	694.6	7897	1.66	796900	167.3	5877001	1234
TOTAL	1579.2	18163	3.81	1732330	363.6	12232902	2568
summer 1988	155.4	2420	0.51	156700	32.9	1010300	212
autumn 1988	236.5	2900	0.61	213970	44.9	1527700	321
winter 1989	257.2	2050	0.43	260440	54.7	2006300	421
spring 1989	790.0	12345	2.59	1004500	210.9	7871301	1652
TOTAL	1439.1	19715	4.14	1635610	343.3	12415601	2606

Table 2.1: Monthly phosphorus budget for Rice Lake for the 1986–87 hydrologic year.
All figures are given in kg., except balance which is given as a percentage.
Sediment loadings were not included in balance calculations.

Supply terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Bewdley North	14.6	5.9	5.0	4.6	3.8	4.1	9.6	8.2	4.5	13.5	6.8	4.2
Bewdley South	47.5	7.0	11.7	23.6	15.7	11.8	18.7	8.2	7.2	108.3	50.8	7.2
Ouse River	177.6	105.8	37.0	37.5	139.7	45.9	61.7	48.2	41.7	209.9	832.0	169.7
Indian River	605.8	178.5	107.1	85.8	165.1	68.7	73.9	38.9	70.2	303.8	334.2	113.0
Otonabee River	8029.0	5768.0	3469.0	6178.0	10170.0	4806.0	3612.0	3170.0	3846.0	4345.0	13470.0	2515.0
Ungauged	367.8	129.3	69.9	65.9	141.1	56.7	71.3	44.9	53.8	276.4	532.3	127.9
Precipitation	381.8	44.3	82.2	31.0	0.0	104.0	351.7	267.8	224.7	326.1	552.6	441.9
Harwood STP	26.7	7.7	19.4	15.8	10.6	9.1	7.1	8.8	12.0	13.5	6.0	14.2
Sediment	1591.6	1644.6	1644.6	1644.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1644.6
Shoreline	149.0	149.0	149.0	149.0	149.0	8.6	8.6	8.6	8.6	8.6	8.6	149.0
TOTAL	9799.7	6395.5	3950.3	6591.2	10794.9	5114.9	4214.7	3603.5	4268.7	5605.2	15793.4	3542.1

Loss terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Trent River	6459.0	2484.0	5021.0	12540.0	12930.0	4029.0	4434.0	2990.0	1305.0	3464.0	10580.0	1731.0
Fish Harvest	433.0	330.0	139.0	162.0	16.0	1.0	0.0	0.0	0.0	0.0	0.0	267.0
TOTAL	6892.0	2814.0	5160.0	12702.0	12946.0	4030.0	4434.0	2990.0	1305.0	3464.0	10580.0	1998.0

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Storage	–223.0	–46.4	–105.7	308.3	–296.7	65.7	–16.4	–38.4	18.8	60.7	119.3	–23.3
Balance (kg) (Out–In+Storage)	–3130.6	–3627.9	1104.0	6419.2	1854.4	–1019.2	202.9	–651.9	–2944.9	–2080.5	–5094.0	–1567.4
Balance (%) (Out/In–Storage)	69%	44%	127%	202%	117%	80%	105%	82%	31%	62%	68%	56%

Table 2.2: Monthly phosphorus budget for Rice Lake for the 1987–88 hydrologic year.
All figures are given in kg., except balance which is given as a percentage.
Sediment loadings were not included in balance calculations.

Supply terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Bewdley North	5.4	4.7	3.9	4.3	5.6	5.3	4.2	14.4	9.9	17.3	6.1	5.9
Bewdley South	8.4	8.2	5.1	21.1	6.9	37.5	33.4	342.9	65.1	880.7	15.6	4.6
Ouse River	95.4	49.9	22.6	8.5	12.3	23.1	101.8	117.4	158.8	227.2	829.0	377.7
Indian River	114.1	279.7	94.5	68.2	94.3	55.7	65.3	138.0	76.3	394.4	207.2	154.0
Otonabee River	2693.0	1770.0	1672.0	1359.0	1081.0	2178.0	3503.0	6216.0	7160.0	9417.0	8541.0	7568.0
Ungauged	97.1	149.0	54.8	44.4	51.7	52.9	89.0	266.5	134.9	661.0	460.2	235.8
Precipitation	270.0	1455.0	1656.0	147.0	106.0	119.0	25.0	517.0	181.0	14.0	606.0	337.0
Harwood STP	26.7	7.7	19.4	15.8	10.6	9.1	7.1	8.8	12.4	13.5	6.0	14.2
Sediment	1591.6	1644.6	1644.6	1644.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1644.6
Shoreline	149.0	149.0	149.0	149.0	149.0	8.6	8.6	8.6	8.6	8.6	8.6	149.0
TOTAL	3459	3873	3677	1817	1517	2489	3837	7630	7807	11634	10680	8846

Loss terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Trent River	1607.0	1406.0	1745.0	3212.0	2516.0	3420.0	3460.0	3397.0	3563.0	3452.0	9990.0	7381.0
Fish Harvest	433.0	330.0	139.0	162.0	16.0	1.0	0.0	0.0	0.0	0.0	0.0	267.0
TOTAL	2040	1736	1884	3374	2532	3421	3460	3397	3563	3452	9990	7648

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Storage	-110.4	0.0	154.2	-93.1	-123.3	0.0	-33.6	35.4	0.0	31.4	223.3	-138.5
Balance (kg) (Out–In+Storage)	-1309	-2137	-1947	1650	1138	932	-344	-4268	-4244	-8213	-913	-1060
Balance (%) (Out/In–Storage)	57%	45%	53%	177%	154%	137%	89%	45%	46%	30%	96%	85%

Table 2.3: Monthly phosphorus budget for Rice Lake for the 1988–89 hydrologic year. All figures are given in kg., except balance which is given as a percentage. Sediment loadings were not included in balance calculations.

Supply terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Bewdley North	7.5	4.0	4.7	13.4	3.3	4.2	6.4	9.7	6.6	12.2	4.7	4.1
Bewdley South	8.6	10.0	5.9	4.7	5.9	11.0	9.5	126.1	285.7	112.6	8.2	6.1
Ouse River	155.1	34.3	14.8	5.4	6.7	20.4	13.8	75.0	76.3	526.9	382.5	649.8
Indian River	120.7	121.6	111.2	82.8	55.2	69.5	43.0	103.8	69.0	906.0	198.5	140.8
Otonabee River	4079.0	1994.0	1922.0	1300.0	1827.0	2449.0	3509.0	3424.0	5616.0	6945.0	8991.0	9931.0
Ungauged	127.0	73.9	59.4	46.2	31.0	45.7	31.6	136.9	190.4	677.5	258.3	348.3
Precipitation	637.9	971.4	178.9	312.3	108.8	53.6	46.2	631.5	284.9	160.5	84.6	14.6
Harwood STP	26.7	7.7	19.4	15.8	10.6	9.1	7.1	8.8	12.0	13.5	6.0	14.2
Sediment	1591.6	1644.6	1644.6	1644.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1644.6
Shoreline	149.0	149.0	149.0	149.0	149.0	8.6	8.6	8.6	8.6	8.6	8.6	149.0
TOTAL	5312	3366	2465	1930	2198	2671	3675	4524	6549	9363	9942	11258

Loss terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Trent River	1444.0	1082.0	1279.0	3040.0	3275.0	3794.0	1774.0	3195.0	1668.0	3137.0	9227.0	10870.0
Fish Harvest	433.0	330.0	139.0	162.0	16.0	1.0	0.0	0.0	0.0	0.0	0.0	267.0
TOTAL	1877	1412	1418	3202	3291	3795	1774	3195	1668	3137	9227	11137

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Storage	−90.9	0.0	55.7	−46.2	−204.6	0.0	0.0	114.1	−37.2	332.1	−237.6	−99.0
Balance (kg) (Out−In+Storage)	−3344	−1954	−1103	1319	1298	1124	−1901	−1444	−4844	−6558	−478	−22
Balance (%) (Out/In−Storage)	35%	42%	59%	162%	137%	142%	48%	72%	25%	35%	91%	98%

Table 2.4: Monthly potassium budget for Rice Lake for the 1986-87 hydrologic year. Supply and loss terms in kg, balance in kg and as a percent.

Supply terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Bewdley North	180	84	106	163	147	142	150	105	90	207	181	73
Bewdley South	259	226	333	559	469	401	549	340	249	1939	1498	326
Ouse River	3137	2545	1345	1897	8282	4711	5249	6294	3088	10850	39480	5717
Indian River	6973	4629	4377	8385	12990	8000	7289	5625	6953	18210	22670	4823
Otonabee River	292000	172700	108800	192900	571900	291800	324900	360200	295500	384500	687100	102200
Ungauged	4588	3255	2679	4786	9520	5765	5757	5377	4514	13573	27763	4758
Precipitation	649	197	1118	1406	0	10	245	245	111	124	167	140
Shoreline	713	813	1177	3071	1150	27	31	55	38	36	17	744
TOTAL	308498	184450	119935	213168	604458	310857	344169	378241	310543	429439	778876	118781

Loss terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Trent River	297600	123300	175800	366800	558900	225300	292500	340700	274600	385300	598800	67340
TOTAL	297600	123300	175800	366800	558900	225300	292500	340700	274600	385300	598800	67340

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Storage	0	-2418	-3826	8171	-13299	4077	-1125	-4507	3912	6712	6798	-890
Balance (kg) (Out-In+Storage)	-10898	-63568	52039	161803	-58857	-81479	-52794	-42048	-32030	-37427	-173277	-52330
Balance (%) (Out/In-Storage)	96%	66%	142%	179%	90%	73%	85%	89%	90%	91%	78%	56%

Table 2.5: Monthly potassium budget for Rice Lake for the 1987–88 hydrologic year. Supply and loss terms in kg, balance in kg and as a percent.

Supply terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Bewdley North	49	90	63	109	143	180	137	275	234	286	214	121
Bewdley South	263	206	226	446	258	425	557	1896	923	7973	615	264
Ouse River	2626	1756	783	626	1300	2739	8257	8338	5826	9696	28660	8841
Indian River	4316	7086	5065	4765	5682	6334	8818	8562	6267	15920	17470	7501
Otonabee River	91570	65840	55220	47720	59770	137200	301700	413700	394100	387200	508500	351300
Ungauged	3155	3975	2669	2586	3211	4210	7729	8295	5763	14735	20426	7276
Precipitation	262	569	828	345	275	247	32	142	67	93	436	376
Shoreline	1318	638	812	868	749	45	21	45	49	42	45	599
TOTAL	103558	183718	145825	123131	128853	222767	478630	768504	854482	849174	1012311	952644

Loss terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Trent River	73610	78970	75090	100300	116800	200700	380700	371300	371300	318800	503800	229600
TOTAL	73610	78970	75090	100300	116800	200700	380700	371300	371300	318800	503800	229600

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Storage	-5643	0	7269	--2882	-5687	0	-3429	3664	0	2627	11959	-4483
Balance (kg) (Out–In+Storage)	–35591	–104748	–63466	–25713	–17740	–22067	–101360	–393541	–483182	–527748	–496552	–727527
Balance (%) (Out/In–Storage)	67%	43%	54%	80%	87%	90%	79%	49%	43%	38%	50%	24%

Table 2.6: Monthly potassium budget for Rice Lake for the 1988–89 hydrologic year. Supply and loss terms in kg, balance in kg and as a percent.

Supply terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Bewdley North	77	58	67	130	157	152	158	243	167	313	193	173
Bewdley South	248	186	222	235	303	296	648	2551	4771	3115	342	398
Ouse River	4117	987	568	456	734	2188	2140	5738	3810	7025	19700	10470
Indian River	5212	6715	5475	5850	5053	5678	3756	5446	4583	25160	16280	12690
Otonabee River	145600	59180	61470	51050	86050	161400	249900	244500	226100	184600	527400	494000
Ungauged	4199	3456	2754	2902	2717	3616	2915	6080	5798	15491	15883	10322
Precipitation	483	665	195	202	188	35	120	202	102	238	99	213
Shoreline	600	595	706	1007	1098	32	33	42	78	256	171	1990
TOTAL	160536	71841	71457	61832	96300	173397	259670	264802	245409	236198	580068	530256

Loss terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Trent River	61880	79200	76110	114200	173100	295500	195800	291300	169700	253700	578300	539200
TOTAL	61880	79200	76110	114200	173100	295500	195800	291300	169700	253700	578300	539200

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Storage	-4031	0	3284	-1669	-10428	0	0	10751	-3725	26866	-14772	-4800
Balance (kg) (Out–In+Storage)	-102687	7359	7937	50699	66373	122103	-63870	37249	-79433	44368	-16540	4144
Balance (%) (Out/In–Storage)	38%	110%	112%	180%	162%	170%	75%	115%	68%	121%	97%	101%

Table 2.7: Monthly chloride budget for Rice Lake for the 1986-87 hydrologic year. Supply and loss terms in kg, balance in kg and as a percent.

Supply terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Bewdley North	1260	469	673	855	804	521	923	585	488	1534	1545	336
Bewdley South	931	734	790	2153	2302	1345	2625	1561	868	7014	5623	1062
Ouse River	34400	26050	13580	15420	59180	44300	54810	73860	37260	78930	292100	63190
Indian River	45640	28970	26740	48830	65580	55240	57780	44920	50300	112300	134100	33780
Otonabee River	2239000	1305000	764400	1437000	3755001	1910000	2342000	2575000	2043000	2738000	4938001	867000
Ungauged	35768	24456	18175	29255	55618	44108	50516	52599	38675	86898	188502	42787
Precipitation	1793	640	1384	643	0	346	1682	1959	3509	1913	945	374
Shoreline	6840	5523	7292	19077	7112	248	264	460	384	349	267	9460
TOTAL	2365632	1391842	833034	1553233	3945597	2056108	2510600	2750944	2174484	3026938	5561083	1017989

Loss terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Trent River	1995000	806100	1093000	2455001	3762001	1496000	2174000	2841001	1958000	2813001	4492000	597500
TOTAL	1995000	806100	1093000	2455001	3762001	1496000	2174000	2841001	1958000	2813001	4492000	597500

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Storage	-71956	-15698	-23663	53609	-89137	27228	-8339	-37544	27859	49232	50573	-8029
Balance (kg) (Out-In+Storage)	-442588	-601440	236304	955377	-272733	-532880	-344939	52513	-188625	-164705	-1018510	-428518
Balance (%) (Out/In-Storage)	82%	57%	128%	164%	93%	74%	86%	102%	91%	94%	82%	58%

Table 2.8: Monthly chloride budget for Rice Lake for the 1987–88 hydrologic year. Supply and loss terms in kg, balance in kg and as a percent.

Supply terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Bewdley North	243	344	375	630	716	1032	943	793	2504	1291	1256	705
Bewdley South	789	609	600	716	758	1150	1737	2321	1706	11640	2376	757
Ouse River	40390	17870	10200	7485	13250	26480	76610	99970	72210	54810	220500	86100
Indian River	25270	48890	34330	33900	40320	48030	67970	54680	45340	78790	107600	57120
Otonabee River	659400	496100	439700	377600	469700	1171000	2765001	3533000	3683001	2516000	3780001	2669001
Ungauged	29009	29453	19793	18586	23942	33358	64053	68622	52962	63732	144294	62932
Precipitation	798	981	680	448	1888	1730	1779	3979	4613	2038	1745	662
Shoreline	6840	5523	7292	19077	7112	248	264	460	384	349	267	9460
TOTAL	762740	599770	512971	458443	557687	1283028	2978357	3763825	3862720	2728650	4258039	2886737

Loss terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Trent River	689100	570500	522400	658100	807300	1459000	3259001	3121001	3013001	2722000	3742000	2264001
TOTAL	689100	570500	522400	658100	807300	1459000	3259001	3121001	3013001	2722000	3742000	2264001

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Storage	-51456	0	50711	-18916	-39007	0	-29008	30404	0	21459	88045	-40948
Balance (kg) (Out–In+Storage)	-125096	-29270	60141	180742	210606	175972	251636	-612420	-849719	14810	-427993	-663684
Balance (%) (Out/In–Storage)	85%	95%	113%	138%	135%	114%	108%	84%	78%	101%	90%	77%

Table 2.9: Monthly chloride budget for Rice Lake for the 1988–89 hydrologic year. Supply and loss terms in kg, balance in kg and as a percent.

Supply terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Bewdley North	464	225	372	1181	656	670	811	1245	769	3200	1457	1133
Bewdley South	614	540	622	709	877	922	1283	5240	6469	6084	1211	2424
Ouse River	45760	11940	6355	6071	9595	28050	26870	51290	56130	54650	158000	129900
Indian River	41460	44230	38120	43870	46000	52620	44710	52060	45560	109000	111500	110200
Otonabee River	1156000	457000	524900	416200	846900	1482000	2166000	2847001	2607001	1587000	4620000	3864001
Ungauged	38406	24765	19777	22545	24848	35781	32046	47775	47380	75221	118385	105983
Precipitation	425	617	366	566	1691	1110	4066	4081	2176	4365	1030	993
Shoreline	6840	5523	7292	19077	7112	248	264	460	384	349	267	9460
TOTAL	1289969	544840	597804	510220	937679	1601401	2276050	3009152	2765869	1839869	5011850	4224094

Loss terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Trent River	586900	538600	463600	716600	1148000	2221001	1623000	2782001	1666000	2252001	4075001	4014001
TOTAL	586900	538600	463600	716600	1148000	2221001	1623000	2782001	1666000	2252001	4075001	4014001

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Storage	-37221	0	20258	-10545	-71479	0	0	101356	-37395	258041	-104913	-37709
Balance (kg) (Out–In+Storage)	-740290	-6240	-113946	195836	138842	619600	-653050	-125795	-1137264	670173	-1041762	-247802
Balance (%) (Out/In–Storage)	44%	99%	80%	138%	114%	139%	71%	96%	59%	142%	80%	94%

Table 2.10: Monthly phosphorus budget for Sturgeon Lake for the 1986-87 hydrologic year. Supply and loss terms in kg, balance in kg and as a percent. Sediment contributions were not included in balance figures.

Supply terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Fenelon Falls	1524.0	896.0	886.6	1944.0	1947.0	1241.0	1252.0	628.7	308.3	679.3	2117.0	569.9
Emily	101.5	15.2	9.3	49.2	225.1	41.0	22.7	16.5	15.3	355.0	167.3	19.8
Hawkers	32.0	11.2	15.8	62.0	19.9	14.5	14.6	8.3	13.8	56.0	45.1	16.5
McLaren	61.4	12.5	21.3	98.4	27.7	21.7	12.1	19.5	15.7	138.1	44.3	13.5
Martin	35.8	11.7	15.9	52.7	24.0	12.9	10.6	9.1	10.3	81.4	42.8	14.0
Rutherford	17.0	2.4	1.0	10.3	4.6	2.7	3.9	1.4	0.9	18.5	8.8	1.3
Scugog River	713	557	894	1256	1476	308	420	260	80	1136	1732	147
Lindsay STP	148	35	117	247	288	144	177	306	460	636	183	297
Lindsay WTP	4.5	0.9	1.0	1.0	1.2	2.0	1.8	1.6	0.5	1.1	1.0	0.1
Fenelon Falls STP	14.5	15.1	18.6	20.3	15.5	12.6	15.2	17.7	5.8	47.5	20.2	5.3
Springdale Gdns STP	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
Ungauged	183.4	45.0	62.9	264.2	107.5	61.9	51.8	45.2	47.0	418.2	192.8	51.7
Precipitation	209.1	31.8	36.9	16.2	0.0	45.3	144.2	153.3	86.5	196.0	221.3	178.7
Shoreline	90.1	90.1	90.1	90.1	90.1	20.8	20.8	20.8	20.8	20.8	20.8	90.1
Sediments	748.9	773.9	773.9	748.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	773.9
Urban Runoff	38.3	30.0	44.8	57.9	41.4	43.1	0.0	0.0	0.0	106.7	35.2	37.4
TOTAL	3170	1764	2210	4151	4266	1967	2186	1527	1105	3824	4836	1446

Loss terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Big Bob Channel	3247	1348	1886	2701	6099	1505	1801	1276	564	4341	3905	765.6
Fish Harvest	36	28	12	14	1	0	0	0	0	0	0	22.4
TOTAL	3283	1376	1898	2715	6100	1505	1801	1276	564	4341	3905	788.0
Storage	-34.4	5.2	-28.3	35.8	-75.2	4.9	55.0	-109.5	-42.5	222.0	63.9	40.2
Balance (kg) (Out-In+Storage)	79	-383	-340	-1400	1759	-457	-330	-361	-584	740	-867	-618
Balance (%) (Out/In-Storage)	102%	78%	85%	66%	141%	77%	85%	78%	49%	121%	82%	56%

Table 2.11: Monthly phosphorus budget for Sturgeon Lake for the 1987-88 hydrologic year. Supply and loss terms in kg, balance in kg and as a percent. Sediment contributions were not included in balance figures.

Supply terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Fenelon Falls	485.5	347.8	505.9	504.3	455.9	562.1	1374.0	475.1	487.0	542.5	2816.0	1463.0
Emily	8.3	5.3	4.2	2.7	5.6	22.9	70.5	59.5	73.7	416.5	179.0	111.8
Hawkers	13.3	12.9	4.3	3.3	7.4	15.2	25.1	23.8	10.6	50.3	72.2	37.7
McLaren	6.0	0.8	0.0	0.0	1.7	11.9	44.4	68.5	52.2	172.3	49.0	46.6
Martin	14.7	9.8	5.1	3.3	2.6	8.6	8.6	36.4	35.0	76.8	38.1	36.8
Rutherford	0.2	0.6	0.0	0.1	0.2	1.7	5.0	9.2	7.9	34.3	16.4	4.8
Scugog River	176	429	214	182	235	985	1075	319	358	500	972	913
Lindsay STP	251	170	248	292	224	251	250	248	283	311	192	534
Lindsay WTP	4.6	1.0	1.0	0.8	1.1	2.0	1.9	0.8	0.5	0.9	1.0	0.0
Fenelon Falls STP	8.5	5.3	5.1	9.9	12.6	26.0	13.7	20.7	12.7	10.7	20.7	11.4
Springdale Gdns STP	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
Ungauged	37.9	27.5	10.6	7.5	13.2	41.4	108.4	157.1	123.2	420.2	239.5	143.9
Precipitation	174.6	848.2	657.4	69.8	45.8	47.5	9.5	343.8	102.3	66.4	225.1	181.9
Shoreline	90.1	90.1	90.1	90.1	90.1	20.8	20.8	20.8	20.8	20.8	20.8	90.1
Sediments	748.9	773.9	773.9	748.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	773.9
Urban Runoff	38.3	30.0	44.8	57.9	41.4	43.1	0.0	0.0	0.0	106.7	35.2	37.4
TOTAL	1307	1988	1786	1205	1134	2035	3046	1823	1607	2662	4882	3616

Loss terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Big Bob Channel	1183	801	779	1091	661	1023	1995	1425	1309	1088	4820	1989
Fish Harvest	36	28	12	14	1	0	0	0	0	0	0	22
TOTAL	1219	829	790	1105	662	1023	1995	1425	1309	1088	4820	2011
Storage	-26.8	0.0	-6.7	0.0	-6.4	10.4	-15.1	-59.3	-52.8	74.6	79.6	0.0
Balance (kg) (Out-In+Storage)	-114.5	-1159.5	-1002.4	-100.4	-478.3	-1001.5	-1066.1	-457.3	-350.8	-1499.4	17.6	-1604.6
Balance (%) (Out/In-Storage)	91%	42%	44%	92%	58%	51%	65%	76%	79%	42%	100%	56%

Table 2.12: Monthly phosphorus budget for Sturgeon Lake for the 1988-89 hydrologic year. Supply and loss terms in kg, balance in kg and as a percent. Sediment contributions were not included in balance figures.

Supply terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Fenelon Falls	670	581	372	667	603	948	603	571	275	521	2410	2383
Emily	15.4	2.3	2.4	5.6	4.4	25.6	15.2	19.8	21.0	809.6	296.2	229.5
Hawkers	9.5	2.9	0.7	2.2	3.1	13.8	7.4	8.2	5.9	122.6	78.1	60.4
McLaren	3.7	0.0	0.2	1.1	4.3	11.5	24.7	48.6	12.9	67.4	29.7	37.2
Martin	15.0	6.5	1.8	5.6	2.6	6.2	11.1	6.9	8.7	160.1	50.2	43.3
Rutherford	1.5	1.2	0.9	1.0	0.2	1.3	1.6	1.7	0.6	39.8	14.2	6.8
Scugog River	218	108	96	74	104	1850	277	385	198	1924	633	721
Lindsay STP	182	237	285	329	313	303	300	494	611	642	316	158
Lindsay WTP	4.2	0.9	1.0	1.1	1.0	1.6	1.8	2.5	0.5	0.5	1.1	0.2
Fenelon Falls STP	3.2	4.5	4.4	5.4	11.1	15.2	9.8	6.6	16.3	12.7	37.6	30.5
Springdale Gdns STP	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
Ungauged	33.9	12.0	5.9	11.3	11.8	41.6	52.3	76.9	33.2	548.0	241.4	202.3
Precipitation	427	618	153	194	52	32	32	43	177	49	42	68
Shoreline	131	131	131	131	131	40	40	40	40	40	40	131
Sediments	749	774	774	749	0	0	0	0	0	0	0	774
Urban Runoff	38.3	30.0	44.8	57.9	41.4	43.1	0.0	0.0	0.0	106.7	35.2	37.4
TOTAL	1710	1704	1052	1427	1241	3310	1396	2113	1421	4958	4210	4071

Loss terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Big Bob Channel	775	939	707	1145	789	966	999	789	263	796	6896	4653
Fish Harvest	36	28	12	14	1	0	0	0	0	0	0	22
TOTAL	811	967	719	1159	790	966	999	789	263	796	6896	4675

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Storage	-7.8	22.9	-18.8	0.0	-23.5	-12.0	18.8	-76.7	-31.8	164.9	-72.9	-20.9
Balance (kg) (Out–In+Storage)	-907	-715	-352	-268	-474	-2356	-379	-1401	-1190	-3997	2613	583
Balance (%) (Out/In–Storage)	47%	57%	67%	81%	62%	29%	73%	36%	18%	17%	161%	114%

Table 2.13: Monthly potassium budget for Sturgeon Lake for the 1986–87 hydrologic year. Supply and loss terms in kg and as a percent

Supply terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Fenelon Falls	102402	78435	79366	104688	223907	93406	172574	108119	63891	81286	145616	52893
Emily	3840	499	135	5330	16021	4562	2359	1616	1146	28180	17255	903
Hawkers	358	212	378	3927	4570	1713	1451	1103	1276	4336	3858	439
McLaren	1774	557	1210	8146	7842	2963	1373	1683	2046	16298	5782	652
Martin	482	164	345	2164	3162	1102	542	422	535	3542	3156	564
Rutherford	973	93	74	964	1031	334	353	198	97	1298	794	85
Scugog River	26578	16602	33385	76311	128803	30785	42220	64401	28188	86820	98892	5321
Lindsay STP	3910	2944	3003	3935	4236	2823	3229	5435	5536	5059	3648	4163
Lindsay WTP	0	0	0	0	0	3	14	22	17	1	2	0
Fenelon Falls STP	280	174	186	237	183	118	154	291	199	286	140	240
Springdale Gdns STP	55	41	42	55	59	39	45	76	77	71	51	58
Ungauged	3900	1281	2450	18308	21621	7584	4761	4183	4606	33192	18181	2093
Precipitation	356	141	501	735	0	4	101	140	43	75	2609	2070
Shoreline	343	392	567	1479	554	66	74	133	92	88	40	358
TOTAL	145253	101535	121642	226279	411988	145502	229251	187823	107748	260532	300023	69840

Loss terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Big Bob Channel	146200	87530	132900	191400	444700	170700	164500	154600	118500	295500	413000	74650
TOTAL	146200	87530	132900	191400	444700	170700	164500	154600	118500	295500	413000	74650
Storage	-2127	434	-2469	2091	-5362	549	5385	-13871	-9106	19510	6935	3857
Balance (kg) (Out–In+Storage)	-1180	-13571	8790	-32788	27349	25748	-59365	-47094	1646	54477	119911	8667
Balance (%) (Out/In–Storage)	99%	87%	107%	85%	107%	118%	73%	77%	101%	123%	141%	113%

Table 2.14: Monthly potassium budget for Sturgeon Lake for the 1987–88 hydrologic year. Supply and loss terms in kg and as a percent

Supply terms	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Fenelon Falls	52930	51570	52626	45108	42926	56205	111271	101052	93479	74536	231852	117556
Emily	254	73	23	50	295	2062	10951	5556	7827	27338	14452	4828
Hawkers	263	385	136	140	501	1278	2132	1599	897	2616	3943	940
McLaren	148	37	0	0	200	1292	4510	4368	3811	6958	3934	1823
Martin	271	224	112	108	195	454	480	1212	805	1561	2020	1081
Rutherford	13	23	1	6	34	187	447	424	351	989	766	314
Scugog River	5673	17724	8700	5659	14289	73585	120426	51359	55801	36959	59734	20349
Lindsay STP	3910	2842	2960	3881	4400	2963	3206	5435	4755	4498	3844	4551
Lindsay WTP	1	0	0	0	0	1	13	40	18	0	1	0
Fenelon Falls STP	280	176	201	243	219	132	148	378	250	316	198	263
Springdale Gdns STP	55	40	41	54	61	41	45	76	66	63	54	63
Ungauged	788	824	309	300	1054	3694	9846	8935	7063	15296	14569	5043
Precipitation	170	332	329	164	119	99	12	94	38	43	162	203
Shoreline	635	307	391	418	361	109	51	110	119	102	108	288
TOTAL	65390	74558	65829	56132	64654	142102	263539	180638	175279	171276	335637	157302
Loss terms												
Big Bob Channel	69600	67440	50040	44600	48290	93860	220100	161500	180000	164300	448300	184300
TOTAL	69600	67440	50040	44600	48290	93860	220100	161500	180000	164300	448300	184300
Storage	-1606	0	-494	0	-470	940	-1550	-6810	-7201	10575	7372	0
Balance (kg) (Out–In+Storage)	2604	-7118	-16283	-11532	-16834	-47303	-44989	-25948	-2480	3599	120034	26998
Balance (%) (Out/In–Storage)	104%	90%	75%	79%	74%	66%	83%	86%	99%	102%	137%	117%

Table 2.15: Monthly potassium budget for Sturgeon Lake for the 1988–89 hydrologic year. Supply and loss terms in kg and as a percent

Supply terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Fenelon Falls	61558	63624	49080	50657	48708	96976	85704	74995	35047	57853	212418	213053
Emily	697	92	101	426	359	2875	2609	3086	2882	29276	26187	17120
Hawkers	129	79	30	121	292	1034	800	866	540	4544	5150	2730
McLaren	132	0	15	137	917	3382	2240	2849	1678	4166	3714	3891
Martin	273	60	46	178	300	777	657	509	437	3408	2521	2012
Rutherford	124	107	85	34	21	174	199	205	49	906	740	443
Scugog River	3888	3373	4115	3558	3278	52851	19201	35505	25713	79642	46277	53260
Lindsay STP	3910	3042	3043	3993	4067	2685	3251	5435	5061	4776	3743	4360
Lindsay WTP	0	1	0	0	0	1	12	1	17	0	2	0
Fenelon Falls STP	283	174	171	231	209	123	148	333	221	301	169	252
Springdale Gdns STP	55	42	42	56	57	37	45	76	71	67	52	61
Ungauged	827	281	191	664	1794	6632	4798	5255	3221	19492	18024	13036
Precipitation	323	423	166	126	90	21	83	138	63	73	49	99
Shoreline	289	286	340	485	529	77	79	102	188	616	412	958
TOTAL	72487	71585	57426	60666	60621	167646	119827	129355	75190	205119	319459	311275

Loss terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Big Bob Channel	55730	53070	47900	57880	40790	115300	111600	103000	45840	110000	527300	367200
TOTAL	55730	53070	47900	57880	40790	115300	111600	103000	45840	110000	527300	367200
Storage	-527	1376	-1335	0	-1210	-1275	2020	-10113	-5914	25481	-5774	-1542
Balance (kg) (Out–In+Storage)	-17285	-17139	-10861	-2786	-21042	-53621	-6207	-36468	-35264	-69638	202067	54382
Balance (%) (Out/In–Storage)	76%	76%	82%	95%	66%	68%	95%	74%	57%	61%	162%	117%

Table 2.16: Monthly chloride budget for Sturgeon Lake for the 1986-87 hydrologic year.

Supply terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Fenelon Falls	531400	449400	409100	522900	1031000	429600	393000	378800	276300	378200	737100	271900
Emily	33502	5689	5212	38163	91611	43804	21140	16171	12751	196457	156504	8508
Hawkers	2515	1632	1820	11420	13940	6663	5678	5056	5235	13460	11470	1879
McLaren	20680	5623	8529	37630	46590	19270	16740	17810	22020	104200	41880	6630
Martin	5396	1490	2032	12750	18460	9351	5658	5334	4963	19280	21210	4695
Rutherford	3348	1076	761	3189	3154	1874	2247	1487	746	6059	3548	575
Scugog River	242288	153642	266723	491640	858784	248672	488511	587382	231292	614445	868442	47268
Lindsay STP	62207	42110	39712	48906	48112	35157	35536	66494	72071	68229	59873	67073
Lindsay WTP	18	32	62	48	25	29	41	85	39	59	37	43
Fenelon Falls STP	1228	665	722	1234	1252	858	1197	1734	1711	3255	3007	1186
Springdale Gdns STP	868	587	554	682	671	490	496	927	1005	952	835	935
Ungauged	96083	24914	31662	162167	224432	97066	79885	74611	77302	404978	232477	34441
Precipitation	982	459	621	336	0	151	690	1121	1352	1150	1755	1353
Shoreline	3294	2659	3511	9186	3425	597	636	1108	924	840	643	4555
TOTAL	1003809	689979	771021	1340250	2341456	893582	1051454	1158121	707711	1811562	2138780	451041

Loss terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Big Bob Channel	1001000	606400	636400	1296000	2611000	953000	1005000	872800	698500	2070000	3111000	500500
TOTAL	1001000	606400	636400	1296000	2611000	953000	1005000	872800	698500	2070000	3111000	500500
Storage	-12249	3064	-10364	14178	-30573	3083	32344	-77020	-53807	138021	53174	25911
Balance (kg) (Out-In+Storage)	-15058	-80515	-144985	-30072	238971	62501	-14110	-362341	-63018	396459	1025394	75370
Balance (%) (Out/In-Storage)	99%	88%	81%	98%	110%	107%	99%	71%	92%	124%	149%	118%

Table 2.17: Monthly chloride budget for Sturgeon Lake for the 1987–88 hydrologic year.

Supply terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Fenelon Falls	273500	274900	282500	236800	208800	266300	540800	487000	443000	354200	1249000	606900
Emily	3704	2200	1367	1384	3621	19000	92914	47186	65631	213781	105551	49117
Hawkers	1205	1408	477	522	1876	3606	10270	5732	4516	7965	12150	5245
McLaren	1659	316	0	0	1635	11930	45130	32750	38380	48520	33710	17530
Martin	2190	1553	861	592	1448	4110	4521	9528	8327	9830	16760	10040
Rutherford	114	107	8	57	282	1511	3498	2932	2191	4918	3681	2742
Scugog River	58914	137293	68384	45918	139948	1059543	1235213	518915	481697	301999	476103	213092
Lindsay STP	62207	42110	37376	47560	49154	30838	33393	65916	60041	62447	57635	67073
Lindsay WTP	58	57	48	46	0	0	39	75	39	55	44	41
Fenelon Falls STP	1127	720	749	1242	1036	578	930	2061	1782	2935	2948	1423
Springdale Gdns STP	868	587	521	663	686	430	466	919	837	871	804	935
Ungauged	12192	9845	4321	3697	13252	51636	166606	123339	130747	199688	208078	94309
Precipitation	517	572	270	214	814	690	692	2645	2613	947	648	357
Shoreline	6088	2085	2423	2597	2230	979	440	914	1192	982	1744	3665
TOTAL	424343	473754	399306	341293	424781	1451150	2134911	1299912	1240993	1209137	2168855	1072469

Loss terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Big Bob Channel	457800	436100	331800	306100	344200	664900	1562000	1111000	1142000	1090000	3526001	1261000
TOTAL	457800	436100	331800	306100	344200	664900	1562000	1111000	1142000	1090000	3526001	1261000
Storage	-10538	0	-3295	0	-3325	6666	-10927	-48217	-45762	69356	58164	0
Balance (kg) (Out-In+Storage)	22919	-37654	-70801	-35193	-83906	-779585	-583838	-237128	-144755	-49782	1415310	188531
Balance (%) (Out/In-Storage)	105%	92%	82%	90%	80%	46%	73%	82%	89%	96%	167%	118%

Table 2.18: Monthly chloride budget for Sturgeon Lake for the 1988-89 hydrologic year.

Supply terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Fenelon Falls	313800	328400	260100	264400	266000	547400	439700	421300	222100	424300	1234000	1096000
Emily	7421	915	2346	9400	6153	35990	37187	30938	36726	174264	161792	195125
Hawkers	1302	649	222	893	2178	7790	6783	8063	5991	12330	17950	20680
McLaren	2123	0	288	1876	11170	35130	28820	37380	26160	51460	33160	39430
Martin	4348	1030	666	2245	4440	11100	14110	10860	11290	27330	25280	23050
Rutherford	1887	1364	1313	513	315	1908	2327	3066	909	5175	4274	4703
Scugog River	44660	44370	42263	37462	32795	494355	218536	385330	288949	489332	395938	670091
Lindsay STP	62207	42110	41714	50701	46525	29465	37678	65916	61626	65338	58754	67073
Lindsay WTP	16	26	20	20	0	0	0	0	3	0	0	18
Fenelon Falls STP	1271	610	692	1225	1061	633	777	1897	1716	3095	2977	1306
Springdale Gdns STP	868	587	582	707	649	411	526	919	860	911	819	935
Ungauged	25583	6993	8173	19259	43778	150677	136164	152026	114662	303393	277281	305303
Precipitation	285	392	312	352	814	662	2825	2792	1353	1336	507	463
Shoreline	2771	1945	2107	3013	3270	697	673	849	1880	5915	6660	12185
TOTAL	468543	429391	360798	392066	419148	1316218	926106	1121337	774224	1564180	2219392	2436363

Loss terms

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Big Bob Channel	360800	343900	305600	394400	281500	851800	924800	766400	315100	811300	3934001	3126001
TOTAL	360800	343900	305600	394400	281500	851800	924800	766400	315100	811300	3934001	3126001
Storage	-3380	8986	-8548	0	-8666	-9255	17047	-74866	-41878	200175	-44515	-12999

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Balance (kg) (Out-In+Storage)	-111123	-76505	-63746	2334	-146314	-473672	15741	-429802	-501002	-552705	1670093	676639
Balance (%) (Out/In-Storage)	76%	82%	83%	101%	66%	64%	102%	64%	39%	59%	174%	128%

Table 3.1: Summary of monthly point source loadings of phosphorus to Rice Lake for 1986–87.

Otonabee River Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Peterborough STP	875	2840	2129	1545	1166	601	1293	1525	1263	1899	1924	1565
Peterborough WTP	8.5	19.1	5.4	9.0	8.9	12.4	1.3	2.8	2.8	1.0	0.4	13.1
Millbrook STP	4.5	3.0	4.5	4.2	9.9	4.0	21.1	2.1	4.6	13.0	11.4	6.3
Woodland Acres STP	12.2	9.8	6.9	4.1	12.7	14.6	16.4	11.8	12.0	31.7	22.8	10.7
Lakefield STP	0.0	0.0	0.0	18.0	0.0	0.0	0.0	0.0	0.0	58.7	31.1	0.0
Cresswood STP	0.0	0.0	0.0	0.0	8.9	0.0	0.0	0.0	0.0	0.0	8.9	0.0
Urban Runoff	149	117	174	225	161	168	0	0	0	416	137	146
Total	1049	2988	2321	1806	1367	800	1332	1541	1282	2420	2136	1741
% of OT1 Load	13.1%	51.8%	66.9%	29.2%	13.4%	16.6%	36.9%	48.6%	33.3%	55.7%	15.9%	69.2%

Ouse River Point Source (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Norwood STP	8.3	7.5	7.5	9.6	11.2	10.3	12.0	8.9	11.4	16.2	10.0	15.3
% of OE1 Load	4.7%	7.1%	20.3%	25.6%	8.0%	22.5%	19.4%	18.5%	27.4%	7.7%	1.2%	9.0%

Rice Lake: All Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Otonabee River	1049	2988	2321	1806	1367	800	1332	1541	1282	2420	2136	1741
Ouse River	8.3	7.5	7.5	9.6	11.2	10.3	12.0	8.9	11.4	16.2	10.0	15.3
Harwood Hatchery	26.7	7.7	19.4	15.8	10.6	9.1	7.1	8.8	12.0	13.5	6.0	14.2
Shoreline Develop.	149	149	149	149	149	9	9	9	9	9	9	149
Total	1233	3153	2497	1980	1538	828	1359	1567	1314	2458	2161	1919
% of Rice Lake Total Loading	12.6%	49.2%	63.1%	30.0%	14.2%	16.2%	32.2%	43.4%	30.7%	43.7%	13.7%	53.9%

Table 3.2: Summary of monthly point source loadings of phosphorus to Rice Lake for 1987-88.

Otonabee River Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Peterborough STP	1526	1986	2114	1363	1105	1321	1558	1474	1342	1351	1232	1263
Peterborough WTP	9.4	15.8	6.4	10.8	8.2	9.5	2.2	9.0	2.0	0.8	0.6	12.3
Millbrook STP	5.7	8.8	5.7	5.7	8.1	2.3	8.9	4.1	8.5	6.5	7.3	9.9
Woodland Acres STP	6.6	12.5	10.0	14.5	19.5	8.9	23.7	14.3	9.3	27.1	8.4	13.3
Lakefield STP	0.0	0.0	0.0	0.0	15.9	19.8	0.0	0.0	5.8	3.0	3.1	0.0
Cresswood STP	0.0	0.0	0.0	0.0	8.9	0.0	0.0	0.0	0.0	0.0	8.9	0.0
Urban Runoff	149	117	174	225	161	168	0	0	0	416	137	146
Total	1697	2140	2310	1619	1326	1529	1592	1501	1368	1805	1397	1444
% of OT1 Load	63.0%	120.9%	138.2%	119.1%	122.7%	70.2%	45.5%	24.1%	19.1%	19.2%	16.4%	19.1%

Ouse River Point Source (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Norwood STP	3.9	5.8	3.5	7.3	7.3	6.4	7.2	8.4	6.9	8.5	10.0	12.1
% of OE1 Load	4.1%	11.6%	15.5%	86.2%	59.5%	27.7%	7.1%	7.2%	4.3%	3.7%	1.2%	3.2%

Rice Lake: All Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Otonabee River	1697	2140	2310	1619	1326	1529	1592	1501	1368	1805	1397	1444
Ouse River	3.9	5.8	3.5	7.3	7.3	6.4	7.2	8.4	6.9	8.5	10.0	12.1
Harwood Hatchery	26.7	7.7	19.4	15.8	10.6	9.1	7.1	8.8	12.4	13.5	6.0	14.2
Shoreline Develop.	149	149	149	149	149	9	9	9	9	9	9	149
Total	1876	2302	2482	1791	1493	1553	1615	1527	1396	1835	1422	1619
% of Rice Lake Total Loading	54.2%	59.4%	67.4%	98.2%	97.9%	62.2%	42.0%	20.0%	17.9%	15.6%	13.3%	18.3%

Table 3.3: Summary of monthly point source loadings of phosphorus to Rice Lake for 1988-89.

Otonabee River Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Peterborough STP	1356	1138	1324	1247	1088	1281	1212	1273	1238	1440	1596	1408
Peterborough WTP	7.8	14.0	8.7	10.5	7.8	9.9	3.3	5.1	2.4	0.7	0.4	12.3
Millbrook STP	4.2	2.7	3.2	37.6	3.7	4.9	4.1	6.0	4.3	6.9	12.5	8.0
Woodland Acres STP	14.5	13.4	11.5	12.5	13.3	12.5	15.5	15.4	5.9	4.5	2.2	4.0
Lakefield STP	0.0	0.0	0.0	0.0	51.9	2.7	0.0	0.0	7.0	25.4	13.2	0.0
Cresswood STP	0.0	0.0	0.0	0.0	8.9	0.0	0.0	0.0	0.0	0.0	8.9	0.0
Urban Runoff	149	117	174	225	161	168	0	0	0	416	137	146
Total	1531	1285	1522	1533	1335	1479	1234	1299	1257	1893	1770	1578
% of OT1 Load	37.5%	64.4%	79.2%	117.9%	73.1%	60.4%	35.2%	37.9%	22.4%	27.3%	19.7%	15.9%

Ouse River Point Source (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Norwood STP	8.9	5.1	6.8	10.4	5.6	7.4	4.8	11.6	11.1	15.0	6.6	12.6
% of OE1 Load	5.7%	14.9%	45.9%	192.1%	83.0%	36.4%	34.9%	15.5%	14.5%	2.8%	1.7%	1.9%

Rice Lake: All Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Otonabee River	1531	1285	1522	1533	1335	1479	1234	1299	1257	1893	1770	1578
Ouse River	8.9	5.1	6.8	10.4	5.6	7.4	4.8	11.6	11.1	15.0	6.6	12.6
Harwood Hatchery	26.7	7.7	19.4	15.8	10.6	9.1	7.1	8.8	12.0	13.5	6.0	14.2
Shoreline Develop.	149	149	149	149	149	9	9	9	9	9	9	149
Total	1716	1447	1697	1708	1500	1504	1255	1328	1289	1931	1792	1753
% of Rice Lake Total Loading	32.2%	42.9%	68.6%	88.1%	68.1%	56.1%	34.1%	29.3%	19.6%	20.6%	18.0%	15.4%

Table 3.4: Summary of seasonal point source loadings of phosphorus to Rice Lake for 1986-87, 1987-88, 1988-89.

Otonabee River Point Sources (kg)

	1986-1987				1987-1988				1988-1989			
	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr
Peterborough STP	5844	3312	4080	5388	5625	3789	4373	3846	3818	3617	3722	4443
Peterborough WTP	33.0	30.3	6.9	14.5	31.6	28.5	13.1	13.7	30.6	28.3	10.8	13.4
Millbrook STP	12.0	18.1	27.8	30.7	20.2	16.1	21.5	23.7	10.1	46.2	14.4	27.4
Woodland Acres STP	28.9	31.4	40.2	65.2	29.1	42.9	47.3	48.8	39.4	38.3	36.8	10.7
Lakefield STP	0.0	18.0	0.0	89.8	0.0	35.7	5.8	6.1	0.0	54.6	7.0	38.6
Cresswood STP	0.0	8.9	0.0	8.9	0.0	8.9	0.0	8.9	0.0	8.9	0.0	8.9
Urban Runoff	440	554	0	699	440	554	0	699	440	554	0	699
Total	6358	3972	4155	6296	6147	4474	4461	4646	4338	4346	3791	5241
% of OT1 Load	36.8%	18.8%	39.1%	31.0%	100.2%	96.9%	26.4%	18.2%	54.3%	77.9%	30.2%	20.3%

Ouse River Point Source (kg)

Norwood STP	23.3	31.1	32.3	41.5	13.2	21.0	22.5	30.6	20.8	23.4	27.5	34.2
% of OE1 Load	7.3%	13.9%	21.3%	3.4%	7.9%	47.9%	6.0%	2.1%	10.2%	72.0%	16.7%	2.2%

Rice Lake: All Point Sources (kg)

Otonabee River	6358	3972	4155	6296	6147	4474	4461	4646	4338	4346	3791	5241
Ouse River	23.3	31.1	32.3	41.5	13.2	21.0	22.5	30.6	20.8	23.4	27.5	34.2
Harwood Hatchery	53.8	35.5	27.9	33.7	53.8	35.5	28.4	33.7	53.8	35.5	27.9	33.7
Shoreline Develop.	447	416	355	386	447	416	355	386	447	416	355	386
Total	6828	4420	4542	6724	6607	4912	4838	5062	4806	4786	4174	5661
% of Rice Lake Total Loading	33.9%	19.5%	36.6%	26.7%	60.0%	82.8%	24.7%	16.1%	43.1%	69.3%	27.7%	18.3%

Table 3.5: Summary of annual point source loadings of phosphorus to Rice Lake for 1986-87, 1987-88, 1988-89.

Otonabee River Point Sources (kg)

	1986–1987	1987–1988	1988–1989
Peterborough STP	18624	17633	15600
Peterborough WTP	84.8	86.9	83.0
Millbrook STP	88.6	81.5	98.1
Woodland Acres STP	165.7	168.1	125.2
Lakefield STP	107.8	47.6	100.2
Cresswood STP	17.8	17.8	17.8
Urban Runoff	1693	1693	1693
Total	20782	19727	17717
% of OT1 Load	30.0%	37.1%	34.1%

Ouse River Point Source (kg)

Norwood STP	128.2	87.3	105.9
% of OE1 Load	6.7%	4.3%	5.4%

Rice Lake: All Point Sources (kg)

Otonabee River	20782	19727	17717
Ouse River	128.2	87.3	105.9
Harwood Hatchery	151.0	151.4	151.0
Shoreline Develop.	1604	1604	1604
Total	22514	21419	19427
% of Rice Lake Total Loading	28.0%	31.5%	30.3%

Table 3.6: Monthly shoreline loading summary for phosphorus for Rice Lake for 1986–87, 1987–88, 1988–89.

1986–1987

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Seasonal	30.70	30.70	30.70	30.70	30.70	0.00	0.00	0.00	0.00	0.00	0.00	30.70
Permanent	8.42	8.42	8.42	8.42	8.42	8.42	8.42	8.42	8.42	8.42	8.42	8.42
Commercial	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Resort	109.80	109.80	109.80	109.80	109.80	0.00	0.00	0.00	0.00	0.00	0.00	109.80
TOTAL	149.09	149.09	149.09	149.09	149.09	8.59	8.59	8.59	8.59	8.59	8.59	149.09

1987–1988

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Seasonal	30.70	30.70	30.70	30.70	30.70	0.00	0.00	0.00	0.00	0.00	0.00	30.70
Permanent	8.42	8.42	8.42	8.42	8.42	8.42	8.42	8.42	8.42	8.42	8.42	8.42
Commercial	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Resort	109.80	109.80	109.80	109.80	109.80	0.00	0.00	0.00	0.00	0.00	0.00	109.80
TOTAL	149.09	149.09	149.09	149.09	149.09	8.59	8.59	8.59	8.59	8.59	8.59	149.09

1988–1989

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Seasonal	30.70	30.70	30.70	30.70	30.70	0.00	0.00	0.00	0.00	0.00	0.00	30.70
Permanent	8.42	8.42	8.42	8.42	8.42	8.42	8.42	8.42	8.42	8.42	8.42	8.42
Commercial	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Resort	109.80	109.80	109.80	109.80	109.80	0.00	0.00	0.00	0.00	0.00	0.00	109.80
TOTAL	149.09	149.09	149.09	149.09	149.09	8.59	8.59	8.59	8.59	8.59	8.59	149.09

Table 3.7: Seasonal and annual summary of loading of phosphorus to Rice Lake from shoreline development. All values are in kg.

	Summer	Autumn	Winter	Spring	Annual
Seasonal	92.10	61.40	0.00	30.70	184
Permanent	25.26	25.26	25.26	25.26	101
Commercial	0.51	0.51	0.51	0.51	2
Resort	329.40	329.40	329.40	329.40	1318
TOTAL	447.27	416.57	355.17	385.87	1604

	Summer	Autumn	Winter	Spring	Annual
Seasonal	92.10	61.40	0.00	30.70	184
Permanent	25.26	25.26	25.26	25.26	101
Commercial	0.51	0.51	0.51	0.51	2
Resort	329.40	329.40	329.40	329.40	1318
TOTAL	447.27	416.57	355.17	385.87	1604

	Summer	Autumn	Winter	Spring	Annual
Seasonal	92.10	61.40	0.00	30.70	184
Permanent	25.26	25.26	25.26	25.26	194
Commercial	0.51	0.51	0.51	0.51	4
Resort	329.40	329.40	329.40	329.40	1318
TOTAL	447.27	416.57	355.17	385.87	1604

Table 3.8: Summary of monthly point source loadings of potassium to Rice Lake for 1986-87.

Otonabee River Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Peterborough STP	10858	10327	11294	13183	24223	11243	12534	14794	10449	16382	14683	11428
Peterborough WTP	21	17	0	0	4	0	0	1	1	0	0	0
Millbrook STP	192	157	196	250	282	198	235	188	154	289	225	170
Woodland Acres STP	32	29	30	46	54	24	31	39	28	70	23	29
Lakefield STP	314	256	248	314	407	328	346	339	300	494	196	348
Cresswood STP	0	0	0	0	149	0	0	0	0	0	56	0
Total	11416	10786	11768	13793	25119	11793	13146	15362	10932	17235	15184	11975
% of OT1 Load	3.9%	6.2%	10.8%	7.2%	4.4%	4.0%	4.0%	4.3%	3.7%	4.5%	2.2%	11.7%

Ouse River Point Source (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Norwood STP	122	112	120	139	210	160	140	164	142	180	162	128
% of OE1 Load	3.9%	4.4%	8.9%	7.3%	2.5%	3.4%	2.7%	2.6%	4.6%	1.7%	0.4%	2.2%

Rice Lake: All Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Otonabee River	11416	10786	11768	13793	25119	11793	13146	15362	10932	17235	15184	11975
Ouse River	122	112	120	139	210	160	140	164	142	180	162	128
Shoreline Develop.	713	813	1177	3071	1150	27	31	55	38	36	17	744
Total	12251	11712	13064	17003	26478	11980	13317	15582	11113	17451	15362	12847
% of Rice Lake Total Loading	4.0%	6.3%	10.9%	8.0%	4.4%	3.9%	3.9%	4.1%	3.6%	4.1%	2.0%	10.8%

Table 3.9: Summary of monthly point source loadings of potassium to Rice Lake for 1987–88.

Otonabee River Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Peterborough STP	10858	10327	11294	13183	24223	11243	12534	14794	10449	16382	14683	11428
Peterborough WTP	23	14	0	0	4	0	0	5	1	0	0	0
Millbrook STP	192	157	196	250	282	198	235	188	154	289	225	170
Woodland Acres STP	32	29	30	46	54	24	31	39	28	70	23	29
Lakefield STP	314	256	248	314	407	328	346	339	300	494	196	348
Cresswood STP	0	0	0	0	228	0	0	0	0	0	564	0
Total	11418	10784	11768	13793	25197	11793	13146	15365	10932	17235	15692	11975
% of OT1 Load	12.5%	16.4%	21.3%	28.9%	42.2%	8.6%	4.4%	3.7%	2.8%	4.5%	3.1%	3.4%

Ouse River Point Source (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Norwood STP	122	112	120	139	210	160	140	164	142	192	159	136
% of OE1 Load	4.6%	6.4%	15.3%	22.1%	16.1%	5.8%	1.7%	2.0%	2.4%	2.0%	0.6%	1.5%

Rice Lake: All Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Otonabee River	11418	10784	11768	13793	25197	11793	13146	15365	10932	17235	15692	11975
Ouse River	122	112	120	139	210	160	140	164	142	192	159	136
Shoreline Develop.	1318	638	812	868	749	45	21	45	49	42	45	599
Total	12858	11533	12700	14800	26156	11998	13308	15575	11124	17470	15896	12710
% of Rice Lake Total Loading	12.4%	14.4%	19.3%	25.8%	36.6%	7.9%	4.7%	3.5%	2.7%	4.0%	2.8%	3.4%

Table 3.10: Summary of monthly point source loadings of potassium to Rice Lake for 1988-89.

Otonabee River Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Peterborough STP	10858	10327	11294	13183	24223	11243	12534	14794	10449	16382	14683	11428
Peterborough WTP	18	12	0	0	4	0	0	3	1	0	0	0
Millbrook STP	192	157	196	250	282	198	235	188	154	289	225	170
Woodland Acres STP	32	29	30	46	54	24	31	39	28	70	23	29
Lakefield STP	314	256	248	314	407	328	346	339	300	494	196	348
Cresswood STP	0	0	0	0	70	0	0	0	0	0	132	0
Total	11414	10782	11768	13793	25039	11793	13146	15363	10932	17235	15260	11975
% of OT1 Load	7.8%	18.2%	19.1%	27.0%	29.1%	7.3%	5.3%	6.3%	4.8%	9.3%	2.9%	2.4%

Ouse River Point Source (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Norwood STP	126	112	118	159	201	156	150	164	142	187	161	132
% of OE1 Load	3.1%	11.4%	20.7%	34.8%	27.4%	7.1%	7.0%	2.9%	3.7%	2.7%	0.8%	1.3%

Rice Lake: All Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Otonabee River	11414	10782	11768	13793	25039	11793	13146	15363	10932	17235	15260	11975
Ouse River	126	112	118	159	201	156	150	164	142	187	161	132
Shoreline Develop.	600	595	706	1007	1098	32	33	42	78	256	171	1990
Total	12140	11489	12591	14959	26338	11981	13329	15570	11152	17678	15592	14097
% of Rice Lake Total Loading	7.6%	16.0%	17.6%	24.2%	27.4%	6.9%	5.1%	5.9%	4.5%	7.5%	2.7%	2.7%

Table 3.11: Summary of seasonal point source loadings of potassium to Rice Lake for 1986-87, 1987-88, 1988-89.

Otonabee River Point Sources (kg)	1986–1987				1987–1988				1988–1989			
	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr
Peterborough STP	32480	48649	37778	42493	32480	48649	37778	42493	32480	48649	37778	42493
Peterborough WTP	37	4	2	0	36	4	5	0	30	4	3	0
Millbrook STP	544	730	578	684	544	730	578	684	544	730	578	684
Woodland Acres STP	91	124	98	122	91	124	98	122	91	124	98	122
Lakefield STP	818	1048	985	1039	818	1048	985	1039	818	1048	985	1039
Cresswood STP	0	149	0	56	0	228	0	564	0	70	0	132
Total	33970	50705	39441	44394	33969	50783	39444	44902	33963	50625	39442	44470
% of OT1 Load	5.9%	4.8%	4.0%	3.8%	16.0%	20.8%	3.6%	3.6%	12.8%	17.0%	5.5%	3.7%

Ouse River Point Source (kg)

Norwood STP	354	508	447	469	354	508	447	488	356	516	456	480
% of OE1 Load	5.0%	3.4%	3.1%	0.8%	6.9%	10.9%	2.0%	1.0%	6.3%	15.3%	3.9%	1.3%

Rice Lake: All Point Sources (kg)

Otonabee River	33970	50705	39441	44394	33969	50783	39444	44902	33963	50625	39442	44470
Ouse River	354	508	447	469	354	508	447	488	356	516	456	480
Shoreline Develop.	2703	4249	124	797	2767	1663	116	686	1901	2138	153	2417
Total	37027	55462	40012	45660	37091	52954	40007	46076	36220	53278	40051	47368
% of Rice Lake Total Loading	6.0%	4.9%	3.9%	3.4%	14.9%	18.9%	3.4%	3.3%	11.9%	16.1%	5.2%	3.5%

Table 3.12: Summary of annual point source loadings of potassium to Rice Lake for 1986-87, 1987-88, 1988-89.

Otonabee River Point Sources (kg)

	1986–1987	1987–1988	1988–1989
Peterborough STP	161399	161399	161399
Peterborough WTP	43	45	37
Millbrook STP	2536	2536	2536
Woodland Acres STP	436	436	436
Lakefield STP	3890	3890	3890
Cresswood STP	205	792	202
Total	168509	169098	168500
% of OT1 Load	4.5%	6.0%	6.8%

Ouse River Point Source (kg)

Norwood STP	1778	1797	1808
% of OE1 Load	1.9%	2.3%	3.1%

Rice Lake: All Point Sources (kg)

Otonabee River	168509	169098	168500
Ouse River	1778	1797	1808
Shoreline Develop.	7873	5232	6609
Total	178160	176127	176917
% of Rice Lake Total Loading	4.3%	5.7%	6.4%

Table 3.13: Monthly shoreline loading summary for potassium for Rice Lake for 1986-87, 1987-88, 1988-89.

1986–1987

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Seasonal	135.2	154.2	223.1	582.2	218.1	0.0	0.0	0.0	0.0	0.0	0.0	141.1
Permanent	42.4	48.4	70.0	182.7	68.4	27.0	30.3	54.1	37.6	35.7	16.2	44.3
Commercial	0.8	0.9	1.3	3.4	1.3	0.5	0.6	1.0	0.7	0.7	0.3	0.8
Resort	534.5	609.9	882.4	2302.7	862.5	0.0	0.0	0.0	0.0	0.0	0.0	557.9
TOTAL	712.9	813.4	1176.7	3071.0	1150.2	27.5	30.8	55.1	38.3	36.3	16.5	744.0

1987–1988

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Seasonal	249.8	120.9	153.9	164.6	142.0	0.0	0.0	0.0	0.0	0.0	0.0	113.5
Permanent	78.4	37.9	48.3	51.7	44.6	44.2	20.9	44.7	48.5	41.7	44.0	35.6
Commercial	1.4	0.7	0.9	0.9	0.8	0.8	0.4	0.8	0.9	0.8	0.8	0.7
Resort	988.1	478.2	608.8	651.1	561.7	0.0	0.0	0.0	0.0	0.0	0.0	448.8
TOTAL	1317.8	637.7	812.0	868.4	749.1	45.0	21.3	45.5	49.4	42.5	44.8	598.6

1988–1989

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Seasonal	113.7	112.8	133.9	191.0	208.2	0.0	0.0	0.0	0.0	0.0	0.0	377.3
Permanent	35.7	35.4	42.0	59.9	65.4	31.5	32.0	41.5	76.5	251.3	168.1	118.4
Commercial	0.7	0.7	0.8	1.1	1.2	0.6	0.6	0.8	1.4	4.6	3.1	2.2
Resort	449.8	446.1	529.4	755.3	823.6	0.0	0.0	0.0	0.0	0.0	0.0	1492.4
TOTAL	599.8	594.9	706.0	1007.3	1098.4	32.1	32.6	42.2	77.9	255.9	171.2	1990.3

Table 3.7: Seasonal and annual summary of loading of potassium to Rice Lake from shoreline development. All values are in kg.

1986–1987

	Summer	Autumn	Winter	Spring	Annual
Seasonal	512	800	0	141	1454
Permanent	161	278	122	96	657
Commercial	3	5	2	2	12
Resort	2027	3165	0	558	5750
TOTAL	2703	4249	124	797	7873

1987–1988

	Summer	Autumn	Winter	Spring	Annual
Seasonal	525	307	0	113	945
Permanent	165	140	114	121	541
Commercial	3	3	2	2	10
Resort	2075	1213	0	449	3737
TOTAL	2767	1663	116	686	5232

1988–1989

	Summer	Autumn	Winter	Spring	Annual
Seasonal	360	399	0	377	1137
Permanent	113	157	150	538	958
Commercial	2	3	3	10	18
Resort	1425	1579	0	1492	4496
TOTAL	1901	2138	153	2417	6609

Table 3.15: Summary of monthly point source loadings of chloride to Rice Lake for 1986–1987.

Otonabee River Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Peterborough STP	130752	115897	106033	128642	144972	113168	121718	214426	157072	182020	235704	153006
Peterborough WTP	460	607	280	208	257	271	112	35	33	51	159	355
Millbrook STP	2341	2287	2241	2341	2968	2279	3190	3166	1812	4297	3992	2786
Woodland Acres ST	307	199	185	288	332	220	263	330	280	671	369	372
Lakefield STP	2240	1831	1773	2240	2691	2341	2469	2422	2594	3530	2104	2484
Cresswood STP	0	0	0	0	984	0	0	0	0	0	602	0
Total	136100	120820	110512	133719	152204	118278	127751	220379	161791	190568	242930	159004
% of OT1 Load	6.1%	9.3%	14.5%	9.3%	4.1%	6.2%	5.5%	8.6%	7.9%	7.0%	4.9%	18.3%

Ouse River Point Source (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Norwood STP	1178	1046	956	945	1242	1133	1470	1510	1306	2525	2126	1566
% of OE1 Load	3.4%	4.0%	7.0%	6.1%	2.1%	2.6%	2.7%	2.0%	3.5%	3.2%	0.7%	2.5%

Rice Lake: All Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Otonabee River	136100	120820	110512	133719	152204	118278	127751	220379	161791	190568	242930	159004
Ouse River	1178	1046	956	945	1242	1133	1470	1510	1306	2525	2126	1566
Shoreline Develop.	6840	5523	7292	19077	7112	248	264	460	384	349	267	9460
Total	144118	127389	118760	153742	160557	119659	129485	222349	163481	193442	245323	170029
% of Rice Lake Total Loading	6.0%	9.1%	13.8%	9.5%	4.0%	5.8%	5.0%	8.0%	7.5%	6.0%	4.4%	16.7%

Table 3.16: Summary of monthly point source loadings of chloride to Rice Lake for 1987–1988.

Otonabee River Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Peterborough STP	130752	115897	106033	128642	144972	113168	121718	214426	157072	182020	235704	153006
Peterborough WTP	510	501	332	250	234	208	180	114	23	38	185	334
Millbrook STP	2341	2287	2241	2341	2968	2279	3190	3166	1812	4297	3992	2786
Woodland Acres ST	307	199	185	288	332	220	263	330	280	671	369	372
Lakefield STP	2240	1831	1773	2240	2691	2341	2469	2422	2594	3530	2104	2484
Cresswood STP	0	0	0	0	1506	0	0	0	0	0	6039	0
Total	136150	120715	110563	133761	152703	118215	127820	220457	161781	190556	248393	158982
% of OT1 Load	20.6%	24.3%	25.1%	35.4%	32.5%	10.1%	4.6%	6.2%	4.4%	7.6%	6.6%	6.0%

Ouse River Point Source (kg)

Norwood STP	1178	1046	956	945	1242	1133	1470	1739	1268	2314	5212	1720
% of OE1 Load	2.9%	5.9%	9.4%	12.6%	9.4%	4.3%	1.9%	1.7%	1.8%	4.2%	2.4%	2.0%

Rice Lake: All Point Sources (kg)

Otonabee River	136150	120715	110563	133761	152703	118215	127820	220457	161781	190556	248393	158982
Ouse River	1178	1046	956	945	1242	1133	1470	1739	1268	2314	5212	1720
Shoreline Develop.	12644	4330	5031	5394	4632	407	183	380	495	408	724	7611
Total	149972	126091	116550	140100	158577	119755	129472	222576	163544	193278	254329	168312
% of Rice Lake Total Loading	19.4%	21.0%	22.3%	29.8%	27.5%	9.1%	4.3%	5.9%	4.1%	6.3%	6.0%	5.9%

Table 3.17: Summary of monthly point source loadings of chloride to Rice Lake for 1988-1989.

Otonabee River Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Peterborough STP	130752	115897	106033	128642	144972	113168	121718	214426	157072	182020	235704	153006
Peterborough WTP	460	441	442	245	226	216	264	66	28	33	143	355
Millbrook STP	2341	2287	2241	2341	2968	2279	3190	3166	1812	4297	3992	2786
Woodland Acres ST	307	199	185	288	332	220	263	330	280	671	369	372
Lakefield STP	2240	1831	1773	2240	2691	2341	2469	2422	2594	3530	2104	2484
Cresswood STP	0	0	0	0	461	0	0	0	0	0	1418	0
Total	136100	120655	110674	133755	151650	118223	127903	220410	161786	190550	243730	159004
% of OT1 Load	6.1%	26.4%	21.1%	32.1%	17.9%	8.0%	5.9%	7.7%	6.2%	12.0%	5.3%	4.1%

Ouse River Point Source (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Norwood STP	1178	769	854	868	1015	1181	1134	1617	1281	2391	3678	1650
% of OE1 Load	3.4%	6.4%	13.4%	14.3%	10.6%	4.2%	4.2%	3.2%	2.3%	4.4%	2.3%	1.3%

Rice Lake: All Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Otonabee River	136100	120655	110674	133755	151650	118223	127903	220410	161786	190550	243730	159004
Ouse River	1178	769	854	868	1015	1181	1134	1617	1281	2391	3678	1650
Shoreline Develop.	6840	4039	4375	6257	6791	289	279	352	780	2456	2765	25305
Total	144118	125463	115903	140881	159457	119693	129316	222380	163848	195397	250173	185958
% of Rice Lake Total Loading	6.0%	23.1%	19.1%	26.3%	16.6%	7.4%	5.6%	7.0%	5.6%	9.5%	5.0%	4.4%

Table 3.18: Summary of seasonal point source loadings of chloride to Rice Lake for 1986-87, 1987-88, 1988-89.

Otonabee River Point Sources (kg)

	1986–1987				1987–1988				1988–1989			
	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr
Peterborough STP	352682	386782	493217	570730	352682	386782	493217	570730	352682	386782	493217	570730
Peterborough WTP	1347	736	180	565	1343	693	317	557	1286	687	358	531
Millbrook STP	6868	7587	8167	11074	6868	7587	8167	11074	6868	7587	8167	11074
Woodland Acres S	691	840	872	1413	691	840	872	1413	691	840	872	1413
Lakefield STP	5843	7272	7485	8117	5843	7272	7485	8117	5843	7272	7485	8117
Cresswood STP	0	984	0	602	0	1506	0	6039	0	461	0	1418
Total	367432	404200	509921	592501	367428	404679	510058	597931	367371	403629	510099	593284
% of OT1 Load	8.5%	5.7%	7.3%	6.9%	23.0%	20.1%	5.1%	6.7%	17.2%	14.7%	6.7%	5.9%

Ouse River Point Source (kg)

Norwood STP	3179	3320	4286	6217	3179	3320	4477	9246	2859	3064	4032	7718
% of OE1 Load	4.3%	2.8%	2.6%	1.4%	4.6%	7.0%	1.8%	2.6%	4.5%	7.0%	3.0%	2.3%

Rice Lake: All Point Sources (kg)

Otonabee River	367432	404200	509921	592501	367428	404679	510058	597931	367371	403629	510099	593284
Ouse River	3179	3320	4286	6217	3179	3320	4477	9246	2859	3064	4032	7718
Shoreline Develop.	19655	26438	1108	10075	22006	10433	1057	8742	14169	13338	1412	30526
Total	390267	433958	515315	608794	392613	418432	515593	615919	384399	420031	515544	631528
% of Rice Lake Total Loading	8.4%	5.6%	6.9%	6.2%	20.7%	17.7%	4.8%	6.1%	15.8%	13.5%	6.1%	5.6%

Table 3.19: Summary of annual point source loadings of chloride to Rice Lake for 1986-87, 1987-88, 1988-89.

Otonabee River Point Sources (kg)

	1986–1987	1987–1988	1988–1989
Peterborough STP	1803410	1803410	1803410
Peterborough WTP	2828	2910	2863
Millbrook STP	2808	2808	2808
Woodland Acres STP	3816	3816	3816
Lakefield STP	28717	28717	28717
Cresswood STP	1586	7546	1880
Total	1843166	1849207	1843494
% of OT1 Load	6.8%	8.2%	8.2%

Ouse River Point Source (kg)

	1986–1987	1987–1988	1988–1989
Norwood STP	17002	20222	17673
% of OE1 Load	2.1%	2.8%	3.0%

Rice Lake: All Point Sources (kg)

	1986–1987	1987–1988	1988–1989
Otonabee River	1843166	1849207	1843494
Ouse River	17002	20222	17673
Shoreline Develop.	57276	42238	59446
Total	1917444	1911667	1920613
% of Rice Lake Total Loading	6.5%	7.6%	7.6%

Table 3.20: Summary of monthly shoreline loading of chloride to Rice Lake for 1986-87, 1987-88, 1988-89.

1986-1987

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Seasonal	1296.8	1047.0	1382.4	3616.7	1348.4	0.0	0.0	0.0	0.0	0.0	0.0	1793.4
Permanent	407.0	328.6	433.9	1135.1	423.2	243.3	259.3	451.7	376.7	342.3	262.0	562.9
Commercial	7.5	6.0	8.0	20.8	7.8	4.5	4.8	8.3	6.9	6.3	4.8	10.3
Resort	5129.1	4140.9	5467.7	14304.8	5333.0	0.0	0.0	0.0	0.0	0.0	0.0	7093.3
TOTAL	6840.4	5522.5	7292.0	19077.5	7112.3	247.8	264.0	460.0	383.7	348.6	266.8	9459.9

1987-1988

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Seasonal	2397.1	820.8	953.9	1022.7	878.2	0.0	0.0	0.0	0.0	0.0	0.0	1442.8
Permanent	752.4	257.6	299.4	321.0	275.6	399.2	179.4	372.8	486.1	400.4	711.0	452.8
Commercial	13.8	4.7	5.5	5.9	5.1	7.3	3.3	6.8	8.9	7.4	13.1	8.3
Resort	9481.1	3246.5	3772.7	4044.8	3473.3	0.0	0.0	0.0	0.0	0.0	0.0	5706.6
TOTAL	12644.4	4329.7	5031.5	5394.3	4632.1	406.5	182.7	379.6	495.0	407.8	724.1	7610.6

1988-1989

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Seasonal	1091.1	765.7	829.4	1186.3	1287.5	0.0	0.0	0.0	0.0	0.0	0.0	4797.3
Permanent	342.5	240.3	260.3	372.3	404.1	284.2	274.3	346.1	766.3	2411.4	2714.9	1505.7
Commercial	6.3	4.4	4.8	6.8	7.4	5.2	5.0	6.4	14.1	44.3	49.9	27.7
Resort	4315.5	3028.4	3280.6	4692.0	5092.4	0.0	0.0	0.0	0.0	0.0	0.0	18974.5
TOTAL	5755.4	4038.9	4375.2	6257.4	6791.5	289.4	279.4	352.5	780.3	2455.7	2764.7	25305.1

Table 3.21: Seasonal and annual summary of shoreline loading of chloride to Rice Lake for 1986–87, 1987–88, 1988–89.

1986–1987

	Summer	Autumn	Winter	Spring	Annual
Seasonal	3726	4965	0	1793	10485
Permanent	1169	1802	1088	1167	5226
Commercial	21	33	20	21	96
Resort	14738	19638	0	7093	41469
TOTAL	19655	26438	1108	10075	57276

1987–1988

	Summer	Autumn	Winter	Spring	Annual
Seasonal	4172	1901	0	1443	7515
Permanent	1309	996	1038	1564	4908
Commercial	24	18	19	29	90
Resort	16500	7518	0	5707	29725
TOTAL	22006	10433	1057	8742	42238

1988–1989

	Summer	Autumn	Winter	Spring	Annual
Seasonal	2686	2474	0	4797	9957
Permanent	843	1061	1387	6632	9922
Commercial	15	19	25	122	182
Resort	10625	9784	0	18974	39383
TOTAL	14169	13338	1412	30526	59446

Table 3.22: Summary of monthly point source loadings of phosphorus to Sturgeon Lake for 1986–87.

Sturgeon Lake Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Lindsay STP	148	35	117	247	288	144	177	306	460	636	183	297
Lindsay WTP	4.6	0.9	1.0	1.0	1.2	2.0	1.8	1.7	0.5	1.1	1.0	0.1
Fenelon Falls STP	14.5	15.1	18.6	20.3	15.5	12.6	15.2	17.7	5.8	47.5	20.2	5.3
Springdale STP	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
Urban	25.2	35.2	37.4	38.3	30.0	44.8	57.9	41.4	43.1	36.1	21.8	23.5
Shoreline Develop.	90.0	90.1	90.1	90.1	90.1	20.8	20.8	20.8	20.8	20.8	20.8	90.1
Total	287	181	269	401	429	229	277	392	535	746	251	420
% of Sturgeon Lake Total Loading	9.1	10.3	12.1	9.7	10.1	11.6	12.6	25.6	48.1	19.5	5.2	29.3

Table 3.23: Summary of monthly point source loadings of phosphorus to Sturgeon Lake for 1987–88.

Sturgeon Lake Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Lindsay STP	251	170	248	292	224	251	250	248	283	311	192	534
Lindsay WTP	4.6	1.0	1.0	0.8	1.0	2.0	1.9	0.8	0.5	0.9	1.0	0.0
Fenelon Falls STP	8.5	5.3	5.1	9.9	12.6	26.0	13.7	20.7	12.7	10.7	20.7	11.4
Springdale STP	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
Urban	25.2	35.2	37.4	38.3	30.0	44.8	57.9	41.4	43.1	36.1	21.8	23.5
Shoreline Develop.	90.1	90.1	90.1	90.1	90.1	20.8	20.8	20.8	20.8	20.8	20.8	90.1
Total	384	306	386	436	362	349	349	336	365	384	261	663

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
% of Sturgeon Lake Total Loading	29.5	15.4	21.6	36.1	32.1	17.1	11.4	18.4	22.4	14.4	5.4	18.4

Table 3.24: Summary of monthly point source loadings of phosphorus to Sturgeon Lake for 1988–89.

Sturgeon Lake Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Lindsay STP	182	237	285	329	313	303	300	494	611	642	316	158
Lindsay WTP	4.2	0.9	1.0	1.1	1.0	1.6	1.8	2.5	0.5	0.5	1.1	0.2
Fenelon Falls STP	3.2	4.5	4.4	5.4	11.1	15.2	9.8	6.6	16.3	12.7	37.6	30.5
Springdale STP	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
Urban	25.2	35.2	37.4	38.3	30.0	44.8	57.9	41.4	43.1	36.1	21.8	23.5
Shoreline Develop.	90.1	90.1	90.1	90.1	90.1	20.8	20.8	20.8	20.8	20.8	20.8	90.1
Total	309	372	422	468	450	390	395	570	696	717	402	307

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
% of Sturgeon Lake Total Loading	18.2	21.9	40.1	32.8	36.4	11.7	27.8	26.9	48.8	14.5	9.6	7.6

Table 3.25: Summary of seasonal point source loadings of phosphorus to Sturgeon Lake for 1986-87, 1987-88, 1988-89.

Sturgeon Lake Point Sources (kg)

	1986–1987				1987–1988				1988–1989			
	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr
Lindsay STP	300	679	943	1116	669	767	781	1037	704	945	1405	1116
Lindsay WTP	6.5	4.3	4.1	2.2	6.6	3.9	3.2	1.9	6.1	3.7	4.7	1.8
Fenelon Falls STP	48.2	48.4	38.7	73.0	18.9	48.5	47.1	42.8	12.1	31.7	32.7	80.8
Springdale STP	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3
Urban	113.1	142.4	0.0	179.3	113.1	142.4	0.0	179.3	113.1	142.4	0.0	179.3
Shoreline Develop.	270.3	200.9	62.3	131.6	270.3	200.9	62.3	131.6	270.3	200.9	62.3	131.6
Total	747	1086	1059	1515	1086	1173	905	1405	1114	1334	1553	1483
% of Sturgeon Lak Total Loading	10.5	10.4	22.5	14.9	21.4	26.6	14.2	12.5	24.9	22.2	32.0	11.2

Table 3.26: Summary of annual point source loadings of phosphorus to Sturgeon Lake for 1986-87, 1987-88, 1988-89.

Sturgeon Lake Point Sources (kg)

	1986–1987	1987–1988	1988–1989
Lindsay STP	3038	3254	4170
Lindsay WTP	17.0	15.6	16.3
Fenelon Falls STP	208.3	157.3	157.3
Springdale STP	53.2	53.2	53.2
Urban	434.8	434.8	434.8
Shoreline Develop.	665.0	665.0	665.0
Total	4401	4566	5482
% of Sturgeon Lake Total Loading	13.6	16.9	19.2

Table 3.27: Summary of monthly shoreline loading of phosphorus to Sturgeon Lake for 1986-87, 1987-88, 1988-89.

1986–1987

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Seasonal	30.5	30.5	30.5	30.5	30.5	0.0	0.0	0.0	0.0	0.0	0.0	30.5
Permanent	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4
Commercial	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Resort	38.8	38.8	38.8	38.8	38.8	0.0	0.0	0.0	0.0	0.0	0.0	38.8
TOTAL	90.1	90.0	90.0	90.0	90.0	20.8	20.8	20.8	20.8	20.8	20.8	90.1

1987–1988

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Seasonal	30.5	30.5	30.5	30.5	30.5	0.0	0.0	0.0	0.0	0.0	0.0	30.5
Permanent	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4
Commercial	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Resort	38.8	38.8	38.8	38.8	38.8	0.0	0.0	0.0	0.0	0.0	0.0	38.8
TOTAL	90.1	90.0	90.0	90.0	90.0	20.8	20.8	20.8	20.8	20.8	20.8	90.1

1988–1989

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Seasonal	30.5	30.5	30.5	30.5	30.5	0.0	0.0	0.0	0.0	0.0	0.0	30.5
Permanent	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4
Commercial	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Resort	38.8	38.8	38.8	38.8	38.8	0.0	0.0	0.0	0.0	0.0	0.0	38.8
TOTAL	90.1	90.0	90.0	90.0	90.0	20.8	20.8	20.8	20.8	20.8	20.8	90.1

Table 3.28: Summary of seasonal and annual shoreline loading of phosphorus to Sturgeon Lake for 1986-87, 1987-88, 1988-89.

	Summer	Autumn	Winter	Spring	Annual
Seasonal	91.5	61.0	0.0	30.5	183.0
Permanent	61.3	61.3	61.3	61.3	245.2
Commercial	1.0	1.0	1.0	1.0	4.0
Resort	116.5	77.7	0.0	38.8	233.0
TOTAL	270.3	201.0	62.3	131.6	665.2

	Summer	Autumn	Winter	Spring	Annual
Seasonal	91.5	61.0	0.0	30.5	183.0
Permanent	61.3	61.3	61.3	61.3	245.2
Commercial	1.0	1.0	1.0	1.0	4.0
Resort	116.5	77.7	0.0	38.8	233.0
TOTAL	270.3	201.0	62.3	131.6	665.2

	Summer	Autumn	Winter	Spring	Annual
Seasonal	91.5	61.0	0.0	30.5	183.0
Permanent	61.3	61.3	61.3	61.3	245.2
Commercial	1.0	1.0	1.0	1.0	4.0
Resort	116.5	77.7	0.0	38.8	233.0
TOTAL	270.3	201.0	62.3	131.6	665.2

Table 3.29: Summary of monthly point source loadings of potassium to Sturgeon Lake for 1986–87.

Sturgeon Lake Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Lindsay STP	3910	2944	3003	3935	4236	2823	3229	5435	5536	5059	3648	4163
Lindsay WTP	0	0	0	0	0	3	14	22	17	1	2	0
Fenelon Falls STP	280	174	186	237	183	118	154	291	199	286	140	240
Springdale STP	55	41	42	55	59	39	45	76	77	71	51	58
Shoreline Develop.	343	392	567	1479	554	66	74	133	92	88	40	358
Total	4588	3551	3798	5706	5032	3049	3516	5958	5921	5505	3881	4820

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
% of Sturgeon Lake Total Loading	3.2	3.5	3.1	2.5	1.2	2.1	1.5	3.2	5.5	2.1	1.3	6.9

Table 3.30: Summary of monthly point source loadings of potassium to Sturgeon Lake for 1987-88.

Sturgeon Lake Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Lindsay STP	3910	2842	2960	3881	4400	2963	3206	5435	4755	4498	3844	4551
Lindsay WTP	1	0	0	0	0	1	13	40	18	0	1	0
Fenelon Falls STP	280	176	201	243	219	132	148	378	250	316	198	263
Springdale STP	55	40	41	54	61	41	45	76	66	63	54	63
Shoreline Develop.	635	307	391	418	361	109	51	110	119	102	108	288
Total	4880	3365	3593	4596	5041	3246	3464	6039	5208	4980	4205	5166

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
% of Sturgeon Lake Total Loading	7.5	4.5	5.5	8.2	7.8	2.3	1.3	3.3	3.0	2.9	1.3	3.3

Table 3.31: Summary of monthly point source loadings of potassium to Sturgeon Lake for 1988-89.

Sturgeon Lake Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Lindsay STP	3910	3042	3043	3993	4067	2685	3251	5435	5061	4776	3743	4360
Lindsay WTP	0	1	0	0	0	1	12	1	17	0	2	0
Fenelon Falls STP	283	174	171	231	209	123	148	333	221	301	169	252
Springdale STP	55	42	42	56	57	37	45	76	71	67	52	61
Shoreline Develop.	289	286	340	485	529	77	79	102	188	616	412	958
Total	4537	3547	3597	4765	4862	2924	3535	5947	5557	5760	4379	5631

% of Sturgeon Lake Total Loading	6.3	5.0	6.3	7.9	8.0	1.7	2.9	4.6	7.4	2.8	1.4	1.8

Table 3.32: Summary of seasonal point source loadings of potassium to Sturgeon Lake for 1986-87, 1987-88, 1988-89.

Sturgeon Lake Point Sources (kg)

	1986–1987				1987–1988				1988–1989			
	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr
Lindsay STP	9858	10993	14200	12871	9713	11244	13396	12893	9996	10746	13747	12879
Lindsay WTP	0	3	53	3	1	1	72	1	1	1	30	2
Fenelon Falls STP	640	539	645	667	657	595	776	778	628	563	703	722
Springdale STP	137	153	198	180	135	157	187	180	139	150	192	180
Shoreline Develop.	1302	2099	299	486	1333	887	280	499	915	1091	368	1987
Total	11937	13787	15394	14206	11838	12884	14711	14351	11681	12552	15039	15770

% of Sturgeon Lak Total Loading	3.2	1.8	2.9	2.3	5.8	4.9	2.4	2.2	5.8	4.3	4.6	1.9

Table 3.33: Summary of annual point source loadings of potassium to Sturgeon Lake for 1986–87, 1987–88, 1988–89.

Sturgeon Lake Point Sources (kg)

	1986–1987	1987–1988	1988–1989
Lindsay STP	47922	47246	47368
Lindsay WTP	59	75	35
Fenelon Falls STP	2490	2805	2617
Springdale STP	668	659	661
Shoreline Develop.	4185	2998	4361
Total	55324	53784	55041
% of Sturgeon Lake Total Loading	2.4	3.1	3.3

Table 3.34: Summary of monthly shoreline loading of potassium to Sturgeon Lake for 1986-87, 1987-88, 1988-89.

1986-1987

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Seasonal	134.55	153.52	222.09	579.60	217.09	0.00	0.00	0.00	0.00	0.00	0.00	140.42
Permanent	102.39	116.82	169.00	441.06	165.20	65.09	73.04	130.63	90.74	86.11	39.15	106.86
Commercial	1.67	1.90	2.75	7.18	2.69	1.06	1.19	2.13	1.48	1.40	0.64	1.74
Resort	104.66	119.42	172.76	450.87	168.87	0.00	0.00	0.00	0.00	0.00	0.00	109.24
TOTAL	343.26	391.65	566.61	1478.71	553.85	66.15	74.23	132.76	92.22	87.51	39.79	358.26

1987-1988

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Seasonal	248.71	120.36	153.24	163.89	141.39	0.00	0.00	0.00	0.00	0.00	0.00	112.97
Permanent	189.26	91.59	116.61	124.71	107.59	106.77	50.54	107.79	117.09	100.72	106.26	85.97
Commercial	3.08	1.49	1.90	2.03	1.75	1.74	0.82	1.75	1.90	1.64	1.73	1.40
Resort	193.47	93.62	119.21	127.49	109.98	0.00	0.00	0.00	0.00	0.00	0.00	87.88
TOTAL	634.52	307.06	390.96	418.12	360.71	108.51	51.36	109.55	118.99	102.36	107.99	288.22

1988-1989

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Seasonal	113.21	112.27	133.26	190.11	207.30	0.00	0.00	0.00	0.00	0.00	0.00	375.64
Permanent	86.15	85.44	101.40	144.67	157.75	76.02	77.28	100.09	184.56	606.58	405.72	285.85
Commercial	1.40	1.39	1.65	2.35	2.57	1.24	1.26	1.63	3.00	9.87	6.60	4.65
Resort	88.06	87.34	103.66	147.89	161.26	0.00	0.00	0.00	0.00	0.00	0.00	292.21
TOTAL	288.82	286.43	339.97	485.02	528.86	77.26	78.54	101.72	187.56	616.45	412.32	958.34

Table 3.35: Summary of seasonal and annual shoreline loading of potassium to Sturgeon Lake for 1986-87, 1987-88, 1988-89.

1986–1987

	Summer	Autumn	Winter	Spring	Annual
Seasonal	510.15	796.69	0.00	140.42	1447.27
Permanent	388.21	671.34	294.41	232.11	1586.08
Commercial	6.32	10.92	4.79	3.78	25.80
Resort	396.85	619.74	0.00	109.24	1125.83
TOTAL	1301.53	2098.70	299.20	485.55	4184.98

1987–1988

	Summer	Autumn	Winter	Spring	Annual
Seasonal	522.31	305.27	0.00	112.97	940.56
Permanent	397.46	339.08	275.42	292.95	1304.91
Commercial	6.47	5.52	4.48	4.77	21.23
Resort	406.30	237.47	0.00	87.88	731.66
TOTAL	1332.54	887.34	279.90	498.57	2998.35

1988–1989

	Summer	Autumn	Winter	Spring	Annual
Seasonal	358.73	397.41	0.00	375.64	1131.77
Permanent	272.98	378.44	361.93	1298.14	2311.49
Commercial	4.44	6.16	5.89	21.12	37.61
Resort	279.06	309.14	0.00	292.21	880.40
TOTAL	915.22	1091.14	367.82	1987.10	4361.28

Table 3.36: Summary of monthly point source loadings of chloride to Sturgeon Lake for 1986-87.

Sturgeon Lake Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Lindsay STP	62207	42110	39712	48906	48112	35157	35536	66494	72071	68229	59873	67073
Lindsay WTP	18	32	62	25	29	29	41	85	39	59	37	43
Fenelon Falls STP	1228	665	722	1234	1252	858	1197	1734	1711	3255	3007	1186
Springdale STP	868	587	554	682	671	490	496	927	1005	952	835	935
Shoreline Develop.	3294	2659	3511	9186	3425	597	636	1108	924	840	643	4555
Total	67615	46054	44562	60055	53485	37131	37905	70350	75750	73334	64394	73793

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
% of Sturgeon Lake Total Loading	6.7	6.7	5.8	4.5	2.3	4.2	3.6	6.1	10.7	4.0	3.0	16.4

Table 3.37: Summary of monthly point source loadings of chloride to Sturgeon Lake for 1987-88.

Sturgeon Lake Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Lindsay STP	62207	42110	37376	47560	49154	30838	33393	65916	60041	62447	57635	67073
Lindsay WTP	58	57	48	46	0	0	39	75	39	55	44	41
Fenelon Falls STP	1127	720	749	1242	1036	578	930	2061	1782	2935	2948	1423
Springdale STP	868	587	521	663	686	430	466	919	837	871	804	935
Shoreline Develop.	6088	2085	2423	2597	2230	979	440	914	1192	982	1744	3665
Total	70348	45559	41118	52110	53105	32825	35268	69885	63891	67291	63175	73137

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
% of Sturgeon Lake Total Loading	16.6	9.6	10.3	15.3	12.5	2.3	1.7	5.4	5.1	5.6	2.9	6.8

Table 3.38: Summary of monthly point source loadings of chloride to Sturgeon Lake for 1988-89.

Sturgeon Lake Point Sources (kg)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Lindsay STP	62207	42110	41714	50701	46525	29465	37678	65916	61626	65338	58754	67073
Lindsay WTP	16	26	20	20	0	0	0	0	3	0	0	18
Fenelon Falls STP	1271	610	692	1225	1061	633	777	1897	1716	3095	2977	1306
Springdale STP	868	587	582	707	649	411	526	919	860	911	819	935
Shoreline Develop.	2771	1945	2107	3013	3270	697	673	849	1880	5915	6660	12185
Total	67133	45278	45115	55666	51505	31206	39654	69582	66084	75260	69210	81517

% of Sturgeon Lake Total Loading	14.3	10.5	12.5	14.2	12.3	2.4	4.3	6.2	8.5	4.8	3.1	3.3

Table 3.39:. Summary of seasonal point source loadings of chloride to Sturgeon Lake for 1986-87, 1987-88, 1988-89.

Sturgeon Lake Point Sources (kg)

	1986–1987				1987–1988				1988–1989			
	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr
Lindsay STP	144030	132175	174102	195175	141694	127552	159350	187154	146032	126691	165221	191164
Lindsay WTP	113	101	165	139	163	46	152	140	62	20	3	18
Fenelon Falls STP	2615	3345	4642	7448	2596	2856	4772	7307	2574	2920	4390	7379
Springdale STP	2009	1843	2428	2722	1976	1779	2222	2610	2037	1767	2304	2666
Shoreline Develop.	9464	13207	2668	6037	10596	5807	2547	6391	6823	6980	3402	24759
Total	158231	150671	184005	211521	157025	138040	169043	203602	157528	138378	175320	225986
% of Sturgeon Lake Total Loading	6.4	3.3	6.3	4.8	12.1	6.2	3.6	4.6	12.5	6.5	6.2	3.6

Table 3.40: Summary of annual point source loadings of chloride to Sturgeon Lake for 1986-87, 1987-88, 1988-89.

Sturgeon Lake Point Sources (kg)

	1986–1987	1987–1988	1988–1989
Lindsay STP	645481	615750	629108
Lindsay WTP	519	502	102
Fenelon Falls STP	18049	17531	17262
Springdale STP	9003	8588	8774
Shoreline Develop.	31377	25341	41964
Total	704429	667712	697210
% of Sturgeon Lake Total Loading	4.9	5.3	5.6

Table 3.41: Summary of monthly shoreline loading of chloride to Sturgeon Lake for 1986-87, 1987-88, 1988-89.

1986-1987

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Seasonal	1291.0	1042.3	1376.2	3600.6	1342.3	0.0	0.0	0.0	0.0	0.0	0.0	1785.4
Permanent	982.4	793.1	1047.3	2739.9	1021.5	587.3	625.8	1090.4	909.4	826.3	632.3	1358.6
Commercial	16.0	12.9	17.0	44.6	16.6	9.6	10.2	17.7	14.8	13.4	10.3	22.1
Resort	1004.3	810.8	1070.6	2800.9	1044.2	0.0	0.0	0.0	0.0	0.0	0.0	1388.9
TOTAL	3293.7	2659.1	3511.1	9185.9	3424.6	596.9	636.0	1108.1	924.1	839.7	642.6	4555.0

1987-1988

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Seasonal	2386.4	817.2	949.6	1018.1	874.2	0.0	0.0	0.0	0.0	0.0	0.0	1436.4
Permanent	1816.0	621.8	722.6	774.7	665.3	963.5	433.0	899.7	1173.4	966.5	1716.2	1093.0
Commercial	29.5	10.1	11.8	12.6	10.8	15.7	7.0	14.6	19.1	15.7	27.9	17.8
Resort	1856.4	635.7	738.7	792.0	680.1	0.0	0.0	0.0	0.0	0.0	0.0	1117.3
TOTAL	6088.4	2084.8	2422.7	2597.4	2230.4	979.2	440.1	914.4	1192.4	982.2	1744.2	3664.5

1988-1989

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Seasonal	1086.2	762.3	825.7	1181.0	1281.8	0.0	0.0	0.0	0.0	0.0	0.0	4775.9
Permanent	826.6	580.1	628.4	898.7	975.4	686.0	662.1	835.5	1849.5	5820.6	6552.9	3634.3
Commercial	13.4	9.4	10.2	14.6	15.9	11.2	10.8	13.6	30.1	94.7	106.6	59.1
Resort	845.0	593.0	642.3	918.7	997.1	0.0	0.0	0.0	0.0	0.0	0.0	3715.2
TOTAL	2771.3	1944.7	2106.7	3013.0	3270.1	697.2	672.9	849.1	1879.6	5915.3	6659.6	12184.6

Table 3.42: Summary of seasonal and annual shoreline loading of chloride to Sturgeon Lake for 1986-87, 1987-88, 1988-89.

1986–1987

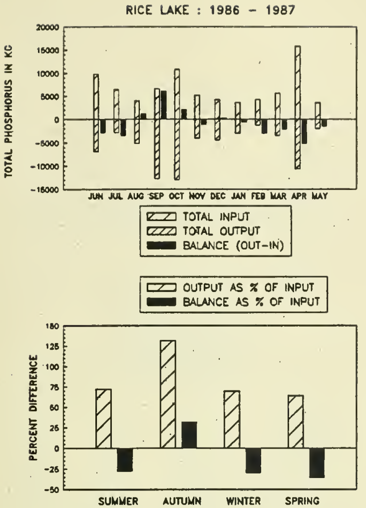
	Summer	Autumn	Winter	Spring	Annual
Seasonal	3709.5	4942.9	0.0	1785.4	10437.8
Permanent	2822.8	4348.7	2625.5	2817.2	12614.3
Commercial	45.9	70.8	42.7	45.8	205.2
Resort	2885.6	3845.1	0.0	1388.9	8119.6
TOTAL	9464.0	13207.4	2668.2	6037.3	31376.9

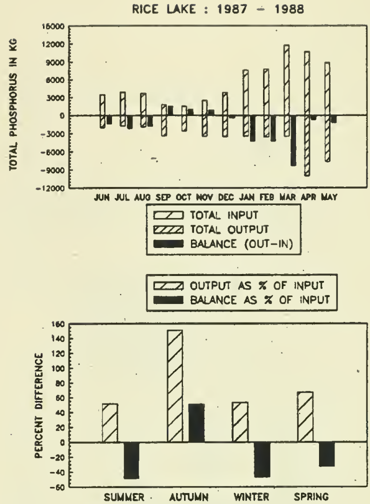
1987–1988

	Summer	Autumn	Winter	Spring	Annual
Seasonal	4153.2	1892.3	0.0	1436.4	7481.9
Permanent	3160.4	2403.5	2506.2	3775.8	11845.9
Commercial	51.4	39.1	40.8	61.4	192.7
Resort	3230.8	1472.0	0.0	1117.3	5820.1
TOTAL	10595.8	5807.0	2546.9	6390.9	25340.6

1988–1989

	Summer	Autumn	Winter	Spring	Annual
Seasonal	2674.3	2462.8	0.0	4775.9	9912.9
Permanent	2035.0	2560.1	3347.2	16007.8	23950.1
Commercial	33.1	41.7	54.5	260.4	389.7
Resort	2080.3	1915.8	0.0	3715.2	7711.3
TOTAL	6822.7	6980.3	3401.6	24759.4	41964.0





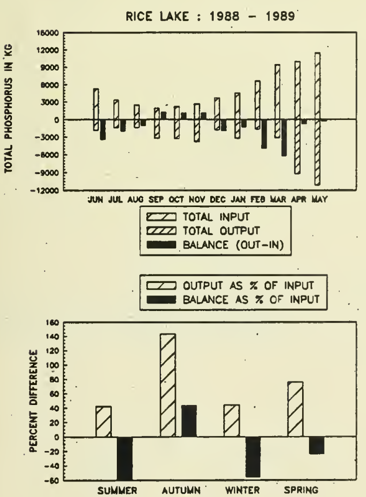
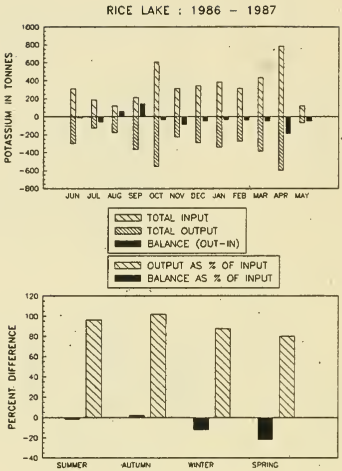
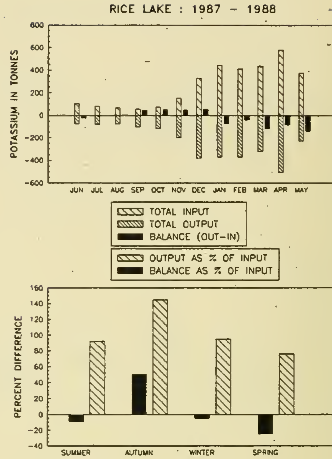


Figure A4-1 : Monthly and seasonal phosphorus balance for Rice Lake in 1986-87 (top left), 1987-88 (top right) and 1988-89 (bottom left).





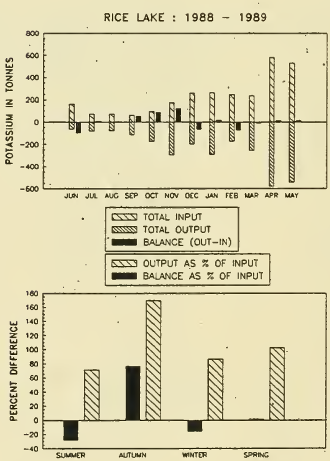
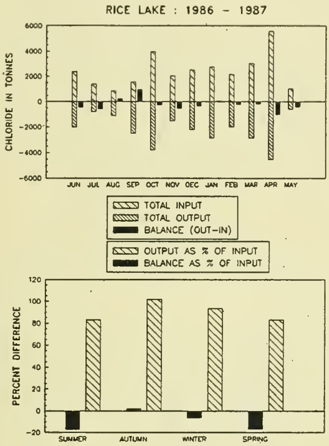
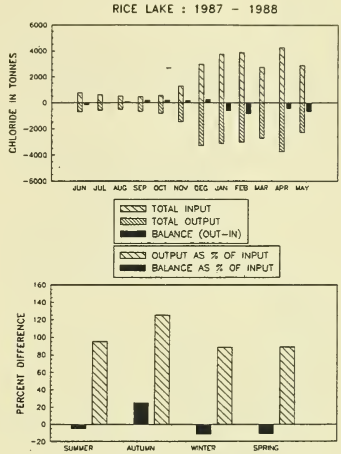


Figure A4-2: Monthly and seasonal potassium balance for Rice Lake for 1986-87 (top left), 1987-88 (top right) and 1988-89 (bottom left)





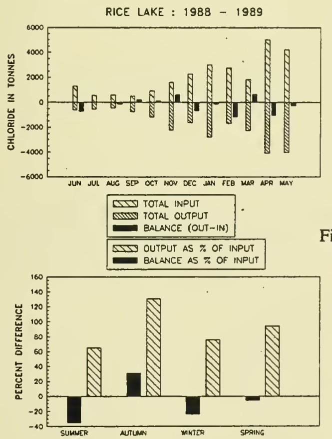
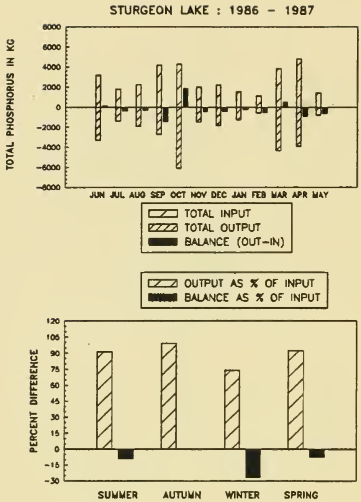
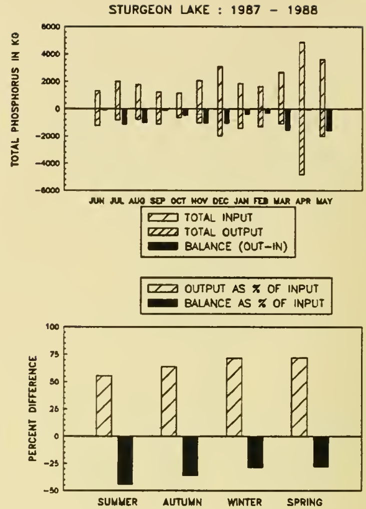


Figure A4-3: Monthly and seasonal chloride balance for Rice Lake for 1986-87 (top left), 1987-88 (top right) and 1988-89 (bottom left).





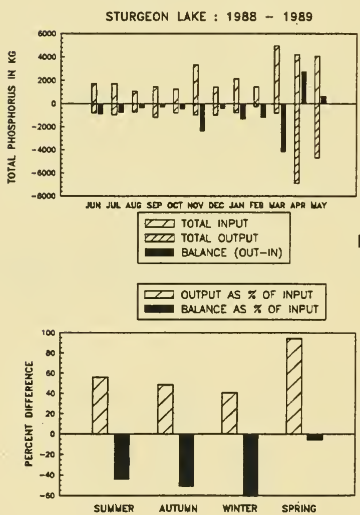
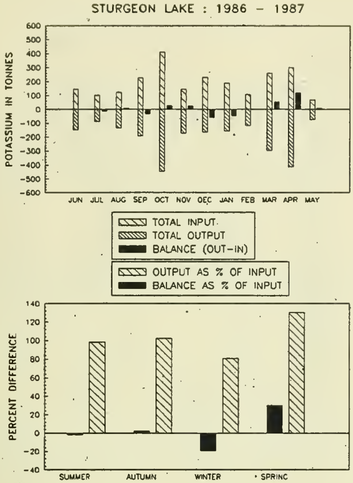
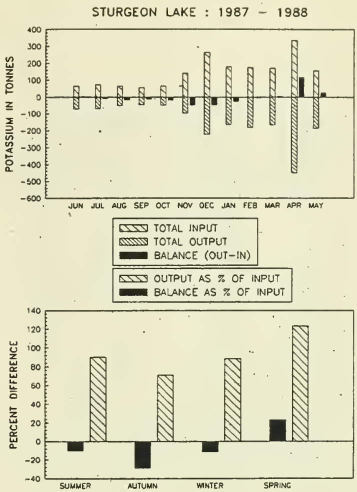


Figure A4-4 : Monthly and seasonal phosphorus balance for Sturgeon Lake in 1986-87 (top left), 1987-88 (top right), and 1988-89 (bottom left).





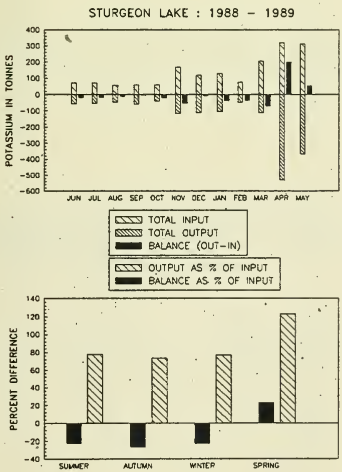
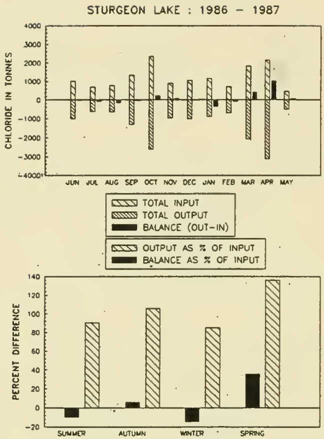
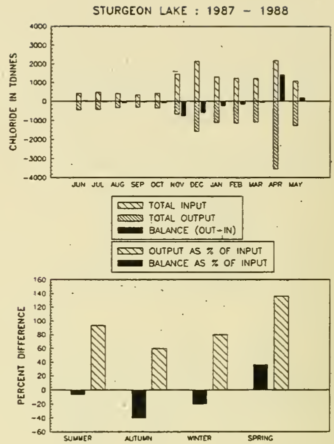


Figure A4-5: Monthly and seasonal potassium balance for Sturgeon Lake for 1986-87, 1987-88 and 1988-89





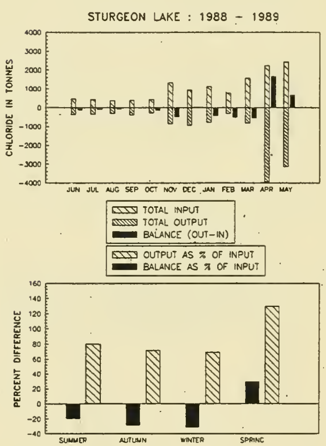


Figure A4–6: **Monthly and seasonal chloride balance for Sturgeon Lake for 1986–87, 1987–88 and 1988–89.**

Table A5-1: Monthly point source loadings to Sturgeon Lake from the Lindsay STP.

Monthly Summary

Lindsay STP

Month	Discharge	Total Phosphorus		Potassium		Chloride	
	(m3x10E6)	(kg)	(mg/L)	(kg)	(mg/L)	(kg)	(mg/L)
8606	494	148	0.30	3910	7.9	62207	126
8607	351	35	0.10	2944	8.4	42110	120
8608	334	117	0.35	3003	9.0	39712	119
8609	449	247	0.55	3935	8.8	48906	109
8610	496	288	0.58	4236	8.5	48112	97
8611	335	144	0.43	2823	8.4	35157	105
8612	369	177	0.48	3229	8.7	35536	96
8701	578	306	0.53	5435	9.4	66494	115
8702	522	460	0.88	5536	10.6	72071	138
8703	578	636	1.10	5059	8.8	68229	118
8704	560	183	0.33	3648	6.5	59873	107
8705	578	297	0.51	4163	7.2	67073	116
8706	494	251	0.51	3910	7.9	62207	126
8707	351	170	0.48	2842	8.1	42110	120
8708	334	248	0.74	2960	8.9	37376	112
8709	449	292	0.65	3881	8.7	47560	106
8710	496	224	0.45	4400	8.9	49154	99
8711	335	251	0.75	2963	8.9	30838	92
8712	369	250	0.68	3206	8.7	33393	90
8801	578	248	0.43	5435	9.4	65916	114
8802	541	283	0.52	4755	8.8	60041	111
8803	578	311	0.54	4498	7.8	62447	108
8804	560	192	0.34	3844	6.9	57635	103
8805	578	534	0.92	4551	7.9	67073	116
8806	494	182	0.37	3910	7.9	62207	126
8807	351	237	0.68	3042	8.7	42110	120
8808	334	285	0.85	3043	9.1	41714	125
8809	449	329	0.73	3993	8.9	50701	113
8810	496	313	0.63	4067	8.2	46525	94
8811	335	303	0.90	2685	8.0	29465	88
8812	369	300	0.81	3251	8.8	37678	102
8901	578	494	0.85	5435	9.4	65916	114
8902	522	611	1.17	5061	9.7	61626	118
8903	578	642	1.11	4776	8.3	65338	113
8904	560	316	0.56	3743	6.7	58754	105
8905	578	158	0.27	4360	7.5	67073	116

Table A5-2: Monthly point source loadings to Sturgeon Lake from the Springdale Gardens STP.

Monthly Summary

Springdale STP

Month	Total Phosphorus (kg)	Lindsay STP Chloride (kg)	Springdale STP Chloride (Est.) (kg)	Lindsay STP Potassium (kg)	Springdale STP Potassium (Est.) (kg)
8606	4.44	62207	868	3910	55
8607	4.44	42110	587	2944	41
8608	4.44	39712	554	3003	42
8609	4.44	48906	682	3935	55
8610	4.44	48112	671	4236	59
8611	4.44	35157	490	2823	39
8612	4.44	35536	496	3229	45
8701	4.44	66494	927	5435	76
8702	4.44	72071	1005	5536	77
8703	4.44	68229	952	5059	71
8704	4.44	59873	835	3648	51
8705	4.44	67073	935	4163	58
8706	4.44	62207	868	3910	55
8707	4.44	42110	587	2842	40
8708	4.44	37376	521	2960	41
8709	4.44	47560	663	3881	54
8710	4.44	49154	686	4400	61
8711	4.44	30838	430	2963	41
8712	4.44	33393	466	3206	45
8801	4.44	65916	919	5435	76
8802	4.44	60041	837	4755	66
8803	4.44	62447	871	4498	63
8804	4.44	57635	804	3844	54
8805	4.44	67073	935	4551	63
8806	4.44	62207	868	3910	55
8807	4.44	42110	587	3042	42
8808	4.44	41714	582	3043	42
8809	4.44	50701	707	3993	56
8810	4.44	46525	649	4067	57
8811	4.44	29465	411	2685	37
8812	4.44	37678	526	3251	45
8901	4.44	65916	919	5435	76
8902	4.44	61626	860	5061	71
8903	4.44	65338	911	4776	67
8904	4.44	58754	819	3743	52
8905	4.44	67073	935	4360	61

Table A5-3: Monthly point source loadings to Sturgeon Lake from the Fenelon Falls STP.

Monthly Summary **Fenelon Falls STP**

Month	Discharge (m3)	Total Phosphorus (kg)	Total Phosphorus (mg/m2)	Potassium (kg)	Potassium (mg/m2)	Chloride (kg)	Chloride (mg/m2)
8606	28890	14.5	0.50	280	9.7	1228	42.5
8607	18941	15.1	0.80	174	9.2	665	35.1
8608	21111	18.6	0.88	186	8.8	722	34.2
8609	28560	20.3	0.71	237	8.3	1234	43.2
8610	25823	15.5	0.60	183	7.1	1252	48.5
8611	15750	12.6	0.80	118	7.5	858	54.5
8612	19778	15.2	0.77	154	7.8	1197	60.5
8701	34689	17.7	0.51	291	8.4	1734	50.0
8702	24864	5.8	0.23	199	8.0	1711	68.8
8703	37200	47.5	1.28	286	7.7	3255	87.5
8704	29190	20.2	0.69	140	4.8	3007	103.0
8705	28582	5.3	0.19	240	8.4	1186	41.5
8706	28890	8.5	0.29	280	9.7	1127	39.0
8707	18941	5.3	0.28	176	9.3	720	38.0
8708	21111	5.1	0.24	201	9.5	749	35.5
8709	28560	9.9	0.35	243	8.5	1242	43.5
8710	25823	12.6	0.49	219	8.5	1036	40.1
8711	15750	26.0	1.65	132	8.4	578	36.7
8712	19778	13.7	0.69	148	7.5	930	47.0
8801	34689	20.7	0.60	378	10.9	2061	59.4
8802	25752	12.7	0.49	250	9.7	1782	69.2
8803	37200	10.7	0.29	316	8.5	2935	78.9
8804	29190	20.7	0.71	198	6.8	2948	101.0
8805	28582	11.4	0.40	263	9.2	1423	49.8
8806	28890	3.2	0.11	283	9.8	1271	44.0
8807	18941	4.5	0.24	174	9.2	610	32.2
8808	21111	4.4	0.21	171	8.1	692	32.8
8809	28560	5.4	0.19	231	8.1	1225	42.9
8810	25823	11.1	0.43	209	8.1	1061	41.1
8811	15750	15.2	0.97	123	7.8	633	40.2
8812	19778	9.8	0.50	148	7.5	777	39.3
8901	34689	6.6	0.19	333	9.6	1897	54.7
8902	24864	16.3	0.66	221	8.9	1716	69.0
8903	37200	12.7	0.34	301	8.1	3095	83.2
8904	29190	37.6	1.29	169	5.8	2977	102.0
8905	28582	30.5	1.07	252	8.8	1306	45.7

Table A5-4a: Monthly point source phosphorus loadings to Sturgeon Lake from the Lindsay WTP.

Monthly Summary   Lindsay WTP – Phosphorus

Month	Flow/Day (m3)	Flow/Month (m3)	Total Phosphorus Backwash (mg/L)	Total Phosphorus Scugog River (mg/L)	Difference (mg/L)	Total Phosphorus Backwash (kg)
8606	227	6819	0.72	0.05	0.67	4.57
8607	227	7046	0.18	0.05	0.13	0.91
8608	227	7046	0.19	0.05	0.14	0.98
8609	227	6819	0.20	0.05	0.15	1.03
8610	227	7046	0.20	0.02	0.18	1.25
8611	227	6819	0.32	0.02	0.30	2.03
8612	227	7046	0.28	0.02	0.26	1.84
8701	236	7328	0.24	0.01	0.23	1.68
8702	223	6237	0.10	0.01	0.09	0.53
8703	227	7046	0.19	0.04	0.15	1.08
8704	227	6819	0.18	0.03	0.15	1.01
8705	227	7046	0.06	0.05	0.01	0.10
8706	227	6819	0.72	0.04	0.68	4.63
8707	227	7046	0.18	0.04	0.14	0.96
8708	227	7046	0.19	0.05	0.14	0.99
8709	227	6819	0.20	0.08	0.12	0.82
8710	227	7046	0.20	0.04	0.16	1.12
8711	227	6819	0.32	0.03	0.29	1.98
8712	227	7046	0.28	0.02	0.26	1.85
8801	236	7328	0.13	0.02	0.11	0.80
8802	223	6237	0.10	0.02	0.08	0.52
8803	227	7046	0.19	0.06	0.13	0.95
8804	227	6819	0.18	0.03	0.15	1.00
8805	227	7046	0.06	0.07	0.00	0.00
8806	227	6819	0.72	0.10	0.62	4.20
8807	227	7046	0.18	0.05	0.13	0.94
8808	227	7046	0.19	0.05	0.14	0.97
8809	227	6819	0.20	0.04	0.16	1.07
8810	227	7046	0.20	0.06	0.14	0.96
8811	227	6819	0.32	0.08	0.24	1.64
8812	227	7046	0.28	0.03	0.25	1.78
8901	245	7610	0.35	0.03	0.32	2.45
8902	218	6110	0.10	0.02	0.08	0.49
8903	227	7046	0.19	0.12	0.07	0.51
8904	227	6819	0.18	0.02	0.16	1.06
8905	230	7117	0.06	0.03	0.03	0.24

Table A5-4b: Monthly point source potassium loadings to Sturgeon Lake from the Lindsay WTP.

Monthly Summary — Lindsay WTP – Potassium

Month	Flow/Day (m3)	Flow/Month (m3)	Potassium Backwash (mg/L)	Potassium Scugog River (mg/L)	Difference (mg/L)	Potassium Backwash (kg)
8606	227	6819	1.70	1.78	-0.08	0.00
8607	227	7046	1.70	2.00	-0.30	0.00
8608	227	7046	1.77	1.91	-0.14	0.00
8609	227	6819	1.85	2.44	-0.59	0.00
8610	227	7046	2.10	2.33	-0.23	0.00
8611	227	6819	2.65	2.20	0.45	3.07
8612	227	7046	4.03	2.06	1.97	13.88
8701	236	7328	5.40	2.35	3.05	22.38
8702	223	6237	5.30	2.65	2.65	16.53
8703	227	7046	2.50	2.30	0.20	1.44
8704	227	6819	2.20	1.96	0.24	1.67
8705	227	7046	1.92	1.95	-0.03	0.00
8706	227	6819	1.70	1.61	0.09	0.63
8707	227	7046	1.70	2.01	-0.31	0.00
8708	227	7046	1.77	2.13	-0.36	0.00
8709	227	6819	1.85	2.25	-0.40	0.00
8710	227	7046	2.10	2.24	-0.14	0.00
8711	227	6819	2.37	2.22	0.15	1.02
8712	227	7046	4.03	2.13	1.90	13.40
8801	236	7328	8.10	2.57	5.53	40.49
8802	223	6237	5.30	2.39	2.91	18.17
8803	227	7046	2.50	2.52	-0.02	0.00
8804	227	6819	2.20	2.06	0.14	0.98
8805	227	7046	1.90	1.84	0.06	0.43
8806	227	6819	1.70	1.96	-0.26	0.00
8807	227	7046	1.70	1.51	0.19	1.36
8808	227	7046	1.77	2.07	-0.30	0.00
8809	227	6819	1.85	2.09	-0.24	0.00
8810	227	7046	2.10	2.34	-0.24	0.00
8811	227	6819	2.65	2.44	0.21	1.45
8812	227	7046	4.03	2.34	1.69	11.90
8901	245	7610	2.70	2.58	0.12	0.91
8902	218	6110	5.30	2.49	2.81	17.17
8903	227	7046	2.50	4.64	-2.14	0.00
8904	227	6819	2.20	1.88	0.32	2.15
8905	230	7117	1.90	1.86	0.04	0.27

Table A5-4c: Monthly point source chloride loadings to Sturgeon Lake from the Lindsay WTP.

Monthly Summary **Lindsay WTP – Chloride**

Month	Flow/Day (m3)	Flow/Month (m3)	Backwash (mg/L)	Total Chloride Scugog River (mg/L)	Difference (mg/L)	Chloride Backwash (kg)
8606	227	6819	25.0	22.3	2.7	18.2
8607	227	7046	23.6	19.0	4.6	32.4
8608	227	7046	24.3	15.4	8.9	62.5
8609	227	6819	24.9	17.9	7.0	47.6
8610	227	7046	19.1	15.6	3.5	24.8
8611	227	6819	21.2	17.0	4.2	28.6
8612	227	7046	26.3	20.4	5.9	41.3
8701	236	7328	31.4	19.7	11.7	85.5
8702	223	6237	28.5	22.3	6.2	38.5
8703	227	7046	25.7	17.3	8.4	59.1
8704	227	6819	22.5	17.1	5.4	36.8
8705	227	7046	23.8	17.6	6.2	43.5
8706	227	6819	25.0	16.5	8.5	58.1
8707	227	7046	23.6	15.6	8.1	56.7
8708	227	7046	24.3	17.5	6.8	48.2
8709	227	6819	24.9	18.1	6.8	46.4
8710	227	7046	19.1	19.2	−0.1	0.0
8711	227	6819	21.2	31.3	−10.1	0.0
8712	227	7046	26.3	20.8	5.6	39.1
8801	236	7328	31.4	21.2	10.2	74.7
8802	223	6237	28.5	22.3	6.2	38.6
8803	227	7046	25.7	17.8	7.9	55.3
8804	227	6819	22.5	16.0	6.5	44.1
8805	227	7046	23.7	17.9	5.8	40.6
8806	227	6819	25.0	22.7	2.3	15.9
8807	227	7046	23.6	20.0	3.6	25.6
8808	227	7046	24.3	21.4	2.9	20.1
8809	227	6819	24.9	22.0	2.9	19.7
8810	227	7046	19.1	25.2	−6.1	0.0
8811	227	6819	21.2	24.8	−3.6	0.0
8812	227	7046	24.0	24.5	−0.5	0.0
8901	245	7610	26.7	28.0	−1.3	0.0
8902	218	6110	28.5	28.0	0.5	3.1
8903	227	7046	25.7	27.0	−1.3	0.0
8904	227	6819	22.5	22.8	−0.3	0.0
8905	230	7117	23.7	21.1	2.6	18.2

Table A5-5: Monthly point source loadings to Rice Lake from the Peterborough STP.

Monthly Summary Peterborough STP

Month	Discharge (m3/day)	Discharge (m3x10E6)	Total Phosphorus (mg/L)	Total Phosphorus (kg)	Potassium (mg/L)	Potassium (kg)	Chloride (mg/L)	Chloride (kg)
8606	50270	1.51	0.58	875	7.2	10858	87	130752
8607	46270	1.43	1.98	2840	7.2	10327	81	115897
8608	46410	1.44	1.48	2129	7.9	11294	74	106033
8609	55980	1.68	0.92	1545	7.9	13183	77	128642
8610	58750	1.82	0.64	1166	13.3	24223	80	144972
8611	47720	1.43	0.41	601	7.6	11243	77	113168
8612	50860	1.58	0.82	1293	8.0	12534	77	121718
8701	53620	1.66	0.92	1525	8.9	14794	129	214426
8702	47540	1.33	0.95	1263	7.9	10449	118	157072
8703	65240	2.02	0.94	1899	8.1	16382	90	182020
8704	64400	1.93	1.00	1924	7.6	14683	122	235704
8705	51200	1.59	0.99	1565	7.2	11428	96	153006
8706	50270	1.51	1.01	1526	7.2	10858	87	130752
8707	46270	1.43	1.38	1986	7.2	10327	81	115897
8708	46410	1.44	1.47	2114	7.9	11294	74	106033
8709	55980	1.68	0.81	1363	7.9	13183	77	128642
8710	58750	1.82	0.61	1105	13.3	24223	80	144972
8711	47720	1.43	0.89	1321	7.6	11243	77	113168
8712	50860	1.58	0.99	1558	8.0	12534	77	121718
8801	53620	1.66	0.89	1474	8.9	14794	129	214426
8802	47540	1.33	1.01	1342	7.9	10449	118	157072
8803	65240	2.02	0.67	1351	8.1	16382	90	182020
8804	64400	1.93	0.64	1232	7.6	14683	122	235704
8805	51200	1.59	0.80	1263	7.2	11428	96	153006
8806	50270	1.51	0.90	1356	7.2	10858	87	130752
8807	46270	1.43	0.79	1138	7.2	10327	81	115897
8808	46410	1.44	0.92	1324	7.9	11294	74	106033
8809	55980	1.68	0.74	1247	7.9	13183	77	128642
8810	58750	1.82	0.60	1088	13.3	24223	80	144972
8811	47720	1.43	0.87	1281	7.6	11243	77	113168
8812	50860	1.58	0.77	1212	8.0	12534	77	121718
8901	53620	1.66	0.77	1273	8.9	14794	129	214426
8902	47540	1.33	0.93	1238	7.9	10449	118	157072
8903	65240	2.02	0.71	1440	8.1	16382	90	182020
8904	64400	1.93	0.83	1596	7.6	14683	122	235704
8905	51200	1.59	0.89	1408	7.2	11428	96	153006

Table A5-6: Monthly point source loadings to Rice Lake from the Millbrook STP.

Monthly Summary Millbrook STP

Month	Discharge (m3/day)	Discharge (m3x10E6)	Total Phosphorus (mg/L)	Total Phosphorus (kg)	Potassium (mg/L)	Potassium (kg)	Chloride (mg/L)	Chloride (kg)
8606	0.830	24.9	0.18	4.5	7.7	192	94	2341
8607	0.683	21.2	0.14	3.0	7.4	157	108	2287
8608	0.725	22.5	0.20	4.5	8.7	196	100	2241
8609	0.868	26.0	0.16	4.2	9.6	250	90	2341
8610	1.059	32.8	0.30	9.9	8.6	282	90	2968
8611	0.840	26.0	0.15	4.0	7.6	198	88	2279
8612	0.999	31.0	0.68	21.1	7.6	235	103	3190
8701	0.920	28.5	0.07	2.1	6.6	188	111	3166
8702	0.764	21.4	0.22	4.6	7.2	154	85	1812
8703	1.260	39.1	0.33	13.0	7.4	289	110	4297
8704	1.088	32.6	0.35	11.4	6.9	225	122	3992
8705	0.806	25.0	0.25	6.3	6.8	170	112	2786
8706	0.830	24.9	0.23	5.7	7.7	192	94	2341
8707	0.683	21.2	0.42	8.8	7.4	157	108	2287
8708	0.725	22.5	0.25	5.7	8.7	196	100	2241
8709	0.868	26.0	0.22	5.7	9.6	250	90	2341
8710	1.059	32.8	0.25	8.1	8.6	282	90	2968
8711	0.840	26.0	0.09	2.3	7.6	198	88	2279
8712	0.999	31.0	0.29	8.9	7.6	235	103	3190
8801	0.920	28.5	0.14	4.1	6.6	188	111	3166
8802	0.764	21.4	0.40	8.5	7.2	154	85	1812
8803	1.260	39.1	0.17	6.5	7.4	289	110	4297
8804	1.088	32.6	0.22	7.3	6.9	225	122	3992
8805	0.806	25.0	0.40	9.9	6.8	170	112	2786
8806	0.830	24.9	0.17	4.2	7.7	192	94	2341
8807	0.683	21.2	0.13	2.7	7.4	157	108	2287
8808	0.725	22.5	0.14	3.2	8.7	196	100	2241
8809	0.868	26.0	1.44	37.6	9.6	250	90	2341
8810	1.059	32.8	0.11	3.7	8.6	282	90	2968
8811	0.840	26.0	0.19	4.9	7.6	198	88	2279
8812	0.999	31.0	0.13	4.1	7.6	235	103	3190
8901	0.920	28.5	0.21	6.0	6.6	188	111	3166
8902	0.764	21.4	0.20	4.3	7.2	154	85	1812
8903	1.260	39.1	0.18	6.9	7.4	289	110	4297
8904	1.088	32.6	0.38	12.5	6.9	225	122	3992
8905	0.806	25.0	0.32	8.0	6.8	170	112	2786

Table A5-7: Monthly point source loadings to Rice Lake from the Lakefield STP.

Monthly Summary Lakefield STP

Month	Discharge (m3/day)	Discharge (m3x10E6)	Total Phosphorus (kg)	Potassium (mg/L)	Potassium (kg)	Chloride (mg/L)	Chloride (kg)
8606	1230	36900	0.0	60.7	2240	8.5	314
8607	973	30163	0.0	60.7	1831	8.5	256
8608	942	29202	0.0	60.7	1773	8.5	248
8609	1230	36900	18.0	60.7	2240	8.5	314
8610	1454	45074	0.0	59.7	2691	9.0	407
8611	1244	38564	0.0	60.7	2341	8.5	328
8612	1312	40672	0.0	60.7	2469	8.5	346
8701	1287	39897	0.0	60.7	2422	8.5	339
8702	1141	31948	0.0	81.2	2594	9.4	300
8703	1876	58156	58.7	60.7	3530	8.5	494
8704	1323	39690	31.1	53.0	2104	5.0	196
8705	1320	40920	0.0	60.7	2484	8.5	348
8706	1230	36900	0.0	60.7	2240	8.5	314
8707	973	30163	0.0	60.7	1831	8.5	256
8708	942	29202	0.0	60.7	1773	8.5	248
8709	1230	36900	0.0	60.7	2240	8.5	314
8710	1454	45074	15.9	59.7	2691	9.0	407
8711	1244	38564	19.8	60.7	2341	8.5	328
8712	1312	40672	0.0	60.7	2469	8.5	346
8801	1287	39897	0.0	60.7	2422	8.5	339
8802	1141	31948	5.8	81.2	2594	9.4	300
8803	1876	58156	3.0	60.7	3530	8.5	494
8804	1323	39690	3.1	53.0	2104	5.0	196
8805	1320	40920	0.0	60.7	2484	8.5	348
8806	1230	36900	0.0	60.7	2240	8.5	314
8807	973	30163	0.0	60.7	1831	8.5	256
8808	942	29202	0.0	60.7	1773	8.5	248
8809	1230	36900	0.0	60.7	2240	8.5	314
8810	1454	45074	51.9	59.7	2691	9.0	407
8811	1244	38564	2.7	60.7	2341	8.5	328
8812	1312	40672	0.0	60.7	2469	8.5	346
8901	1287	39897	0.0	60.7	2422	8.5	339
8902	1141	31948	7.0	81.2	2594	9.4	300
8903	1876	58156	25.4	60.7	3530	8.5	494
8904	1323	39690	13.2	53.0	2104	5.0	196
8905	1320	40920	0.0	60.7	2484	8.5	348

Table A5-8: Monthly point source loadings to Rice Lake from the Norwood STP.

Monthly Summary **Norwood STP**

Month	Discharge		Total Phosphorus		Potassium		Chloride	
	(m3/day)	(m3x10E6)	(mg/L)	(kg)	(mg/L)	(kg)	(mg/L)	(kg)
8606	429	12870	0.64	8.3	9.5	122	92	1178
8607	377	11687	0.64	7.5	9.6	112	90	1046
8608	376	11656	0.64	7.5	10.3	120	82	956
8609	420	12600	0.76	9.6	11.0	139	75	945
8610	463	14353	0.78	11.2	14.6	210	87	1242
8611	441	13671	0.75	10.3	11.7	160	83	1133
8612	439	13609	0.88	12.0	10.3	140	108	1470
8701	510	15810	0.56	8.9	10.4	164	96	1510
8702	453	12684	0.90	11.4	11.2	142	103	1306
8703	617	19127	0.85	16.2	9.4	180	132	2525
8704	581	17430	0.57	10.0	9.3	162	122	2126
8705	451	13981	1.09	15.3	9.2	128	112	1566
8706	429	12870	0.30	3.9	9.5	122	92	1178
8707	377	11687	0.50	5.8	9.6	112	90	1046
8708	376	11656	0.30	3.5	10.3	120	82	956
8709	420	12600	0.58	7.3	11.0	139	75	945
8710	463	14353	0.51	7.3	14.6	210	87	1242
8711	441	13671	0.47	6.4	11.7	160	83	1133
8712	439	13609	0.53	7.2	10.3	140	108	1470
8801	510	15810	0.53	8.4	10.4	164	110	1739
8802	453	12684	0.54	6.9	11.2	142	100	1268
8803	617	19127	0.44	8.5	10.1	192	121	2314
8804	581	17430	0.57	10.0	9.2	159	299	5212
8805	451	13981	0.87	12.1	9.8	136	123	1720
8806	429	12870	0.69	8.9	9.8	126	96	1236
8807	377	11687	0.44	5.1	9.6	112	66	769
8808	376	11656	0.58	6.8	10.1	118	73	854
8809	420	12600	0.83	10.4	12.6	159	69	868
8810	463	14353	0.39	5.6	14.0	201	71	1015
8811	441	13671	0.54	7.4	11.4	156	86	1181
8812	439	13609	0.35	4.8	11.0	150	83	1134
8901	510	15810	0.73	11.6	10.4	164	102	1617
8902	453	12684	0.88	11.1	11.2	142	101	1281
8903	617	19127	0.78	15.0	9.8	187	125	2391
8904	581	17430	0.38	6.6	9.2	161	211	3678
8905	451	13981	0.90	12.6	9.5	132	118	1650

Table A5-9: Monthly point source loadings to Rice Lake from the Crestwood STP.

Monthly Summary — Crestwood STP

Month	Total Phosphorus Lakefield (kg)	Total Phosphorus Crestwood (kg)	Ratio Lakefield TP/ Crestwood TP	Potassium Lakefield (kg)	Potassium Crestwood (kg)	Chloride Lakefield (kg)	Chloride Crestwood (kg)
8610	0.0	8.9	0.00	407	149	2691	984
8704	31.1	8.9	3.49	196	56	2104	602
8710	15.9	8.9	1.79	407	228	2691	1506
8804	3.1	8.9	0.35	196	564	2104	6039
8810	51.9	8.9	5.83	407	70	2691	461
8904	13.2	8.9	1.48	196	132	2104	1418

Table A5-10: Monthly point source loadings to Rice Lake from the Woodland Acres STP.

Monthly Summary **Woodland STP**

Month	Discharge (m3/day)	(m3x10E6)	Total Phosphorus (mg/L)	(kg)	Potassium (mg/L)	(kg)	Chloride (mg/L)	(kg)
8606	254	7620	12.2	1.60	4.2	32.0	40.3	307.1
8607	166	5146	9.8	1.90	5.7	29.3	38.7	199.2
8608	158	4898	6.9	1.41	6.1	29.9	37.8	185.1
8609	234	7020	4.1	0.58	6.6	46.3	41.0	287.8
8610	289	8959	12.7	1.42	6.0	53.8	37.1	332.4
8611	187	5797	14.6	2.52	4.2	24.3	37.9	219.7
8612	225	6975	16.4	2.35	4.4	30.7	37.7	263.0
8701	260	8060	11.8	1.46	4.9	39.5	40.9	329.7
8702	212	5936	12.0	2.02	4.7	27.9	47.1	279.6
8703	480	14880	31.7	2.13	4.7	69.9	45.1	671.1
8704	231	6930	22.8	3.29	3.3	22.9	53.3	369.4
8705	270	8370	10.7	1.28	3.5	29.3	44.5	372.5
8706	254	7620	6.6	0.87	4.2	32.0	40.3	307.1
8707	166	5146	12.5	2.43	5.7	29.3	38.7	199.2
8708	158	4898	10.0	2.04	6.1	29.9	37.8	185.1
8709	234	7020	14.5	2.07	6.6	46.3	41.0	287.8
8710	289	8959	19.5	2.18	6.0	53.8	37.1	332.4
8711	187	5797	8.9	1.54	4.2	24.3	37.9	219.7
8712	225	6975	23.7	3.40	4.4	30.7	37.7	263.0
8801	260	8060	14.3	1.77	4.9	39.5	40.9	329.7
8802	212	5936	9.3	1.57	4.7	27.9	47.1	279.6
8803	480	14880	27.1	1.82	4.7	69.9	45.1	671.1
8804	231	6930	8.4	1.21	3.3	22.9	53.3	369.4
8805	270	8370	13.3	1.59	3.5	29.3	44.5	372.5
8806	254	7620	14.5	1.90	4.2	32.0	40.3	307.1
8807	166	5146	13.4	2.60	5.7	29.3	38.7	199.2
8808	158	4898	11.5	2.35	6.1	29.9	37.8	185.1
8809	234	7020	12.5	1.78	6.6	46.3	41.0	287.8
8810	289	8959	13.3	1.48	6.0	53.8	37.1	332.4
8811	187	5797	12.5	2.16	4.2	24.3	37.9	219.7
8812	225	6975	15.5	2.22	4.4	30.7	37.7	263.0
8901	260	8060	15.4	1.91	4.9	39.5	40.9	329.7
8902	212	5936	5.9	0.99	4.7	27.9	47.1	279.6
8903	480	14880	4.5	0.30	4.7	69.9	45.1	671.1
8904	231	6930	2.2	0.32	3.3	22.9	53.3	369.4
8905	270	8370	4.0	0.48	3.5	29.3	44.5	372.5

Table A5-11a: Monthly point source loadings of total phosphorus to the Otonabee River from filter backwash at the Peterborough WTP. Backwash concentrations were prorated from three measurements made during each 10-minute backwash cycle.

Monthly Summary — Peterborough WTP – Total Phosphorus

Month	Flow	Backwash	Effluent	tonabee River		Total Loading
	(m3)	(ug/L)	(kg)	(ug/L)	(kg)	(kg)
8606	66158	129	10.1	23	1.52	8.53
8607	93898	203	20.9	19	1.78	19.08
8608	43001	126	6.2	18	0.77	5.42
8609	37741	238	9.4	12	0.45	8.98
8610	55166	162	9.5	10	0.56	8.94
8611	56402	220	13.3	16	0.90	12.41
8612	22857	59	1.5	8	0.18	1.34
8701	7969	348	2.8	8	0.06	2.77
8702	7578	373	2.9	9	0.07	2.83
8703	9483	104	1.1	8	0.08	0.99
8704	27276	16	0.9	19	0.52	0.43
8705	59207	222	14.1	17	1.01	13.12
8706	73250	129	11.1	23	1.68	9.45
8707	77596	203	17.2	19	1.47	15.77
8708	50888	126	7.3	18	0.92	6.41
8709	45342	238	11.3	12	0.54	10.79
8710	50320	162	8.7	10	0.50	8.15
8711	43296	220	10.2	16	0.69	9.53
8712	36868	59	2.5	8	0.29	2.17
8801	25867	348	9.2	8	0.21	9.00
8802	5228	375	2.0	7	0.04	1.96
8803	7183	105	0.8	7	0.05	0.75
8804	31777	18	1.1	17	0.54	0.57
8805	55643	222	13.3	17	0.95	12.33
8806	57825	135	8.8	17	0.98	7.81
8807	68326	205	15.2	17	1.16	14.02
8808	67826	129	9.8	15	1.02	8.75
8809	44324	238	11.1	12	0.53	10.55
8810	48597	161	8.4	11	0.53	7.82
8811	44960	220	10.6	16	0.72	9.89
8812	54006	61	3.6	6	0.32	3.28
8901	14747	348	5.3	8	0.12	5.13
8902	6410	371	2.4	11	0.07	2.38
8903	6769	103	0.8	9	0.06	0.70
8904	30349	14	1.1	21	0.64	0.42
8905	55498	222	13.2	17	0.94	12.30

Table A5-11b: Monthly point source loadings of potassium to the Otonabee River from filter backwash at the Peterborough WTP. Backwash concentrations were prorated from three measurements made during each 10-minute backwash cycle.

Monthly Summary — Peterborough WTP – Potassium

Month	Flow	Backwash	Effluent	Otonabee River		Total Loading
	(m3)	(mg/L)	(kg)	(mg/L)	(kg)	(kg)
8606	66158	1.43	94.6	1.12	74.1	20.5
8607	93898	1.15	108.0	0.97	91.5	16.5
8608	43001	0.86	37.0	0.95	40.6	0
8609	37741	0.87	33.0	0.90	33.9	0
8610	55166	0.93	51.3	0.86	47.3	4.0
8611	56402	0.82	46.2	0.90	50.9	0
8612	22857	1.08	24.7	1.10	25.1	0
8701	7969	1.15	9.2	0.96	7.7	1.5
8702	7578	1.21	9.2	1.09	8.3	0.9
8703	9483	1.17	11.1	1.18	11.2	0
8704	27276	1.19	32.5	1.20	32.8	0
8705	59207	0.38	22.6	1.00	59.1	0
8706	73250	1.43	104.7	1.12	82.0	22.7
8707	77596	1.15	89.2	0.97	75.6	13.7
8708	50888	0.86	43.8	0.95	48.1	0
8709	45342	0.87	39.7	0.90	40.7	0
8710	50320	0.93	46.8	0.86	43.1	3.7
8711	43296	0.82	35.5	0.90	39.1	0
8712	36868	1.08	39.9	1.10	40.4	0
8801	25867	1.15	29.7	0.96	24.9	4.8
8802	5228	1.21	6.3	1.09	5.7	0.6
8803	7183	1.17	8.4	1.18	8.5	0
8804	31777	1.19	37.9	1.20	38.3	0
8805	55643	0.38	21.3	1.00	55.6	0
8806	57825	1.43	82.7	1.12	64.8	17.9
8807	68326	1.15	78.6	0.97	66.5	12.0
8808	67826	0.86	58.3	0.95	64.1	0
8809	44324	0.88	38.8	0.90	39.8	0
8810	48597	0.93	45.2	0.86	41.6	3.6
8811	44960	0.82	36.9	0.90	40.6	0
8812	54006	1.08	58.4	1.10	59.2	0
8901	14747	1.15	17.0	0.96	14.2	2.7
8902	6410	1.21	7.8	1.09	7.0	0.8
8903	6769	1.17	7.9	1.18	8.0	0
8904	30349	1.19	36.2	1.20	36.5	0
8905	55498	0.38	21.2	1.00	55.4	0

Table A5-11c: Monthly point source loadings of chloride to the Otonabee River from filter backwash at the Peterborough WTP. Backwash concentrations were prorated from three measurements made during each 10-minute backwash cycle.

Monthly Summary — Peterborough WTP – Chloride

Month	Flow	Backwash Effluent		Otonabee River		Total Loading
	(m3)	(mg/L)	(kg)	(mg/L)	(kg)	(kg)
8606	66158	14.3	943.4	7.3	483.0	460.5
8607	93898	13.8	1292.0	7.3	685.5	606.6
8608	43001	13.3	572.8	6.8	292.4	280.4
8609	37741	12.1	457.4	6.6	249.1	208.3
8610	55166	11.6	637.7	6.9	380.6	257.1
8611	56402	11.7	659.9	6.9	389.2	270.7
8612	22857	11.9	271.5	7.0	160.0	111.5
8701	7969	12.1	96.4	7.7	61.4	35.1
8702	7578	13.0	98.7	8.6	65.2	33.5
8703	9483	13.3	125.7	7.9	74.9	50.8
8704	27276	14.1	385.1	8.3	226.4	158.7
8705	59207	13.7	811.1	7.7	455.9	355.2
8706	73250	14.3	1044.5	7.3	534.7	509.8
8707	77596	13.8	1067.7	7.3	566.4	501.3
8708	50888	13.3	677.8	6.8	346.0	331.8
8709	45342	12.1	549.5	6.6	299.3	250.3
8710	50320	11.6	581.7	6.9	347.2	234.5
8711	43296	11.7	506.6	6.9	298.7	207.8
8712	36868	11.9	438.0	7.0	258.1	179.9
8801	25867	12.1	313.0	7.7	199.2	113.8
8802	5228	13.0	68.1	8.6	45.0	23.1
8803	7183	13.3	95.2	7.9	56.7	38.5
8804	31777	14.1	448.7	8.3	263.7	184.9
8805	55643	13.7	762.3	7.7	428.5	333.9
8806	57825	14.3	824.6	7.3	422.1	402.5
8807	68326	13.8	940.2	7.3	498.8	441.4
8808	67826	13.3	903.4	6.8	461.2	442.2
8809	44324	12.1	537.2	6.6	292.5	244.7
8810	48597	11.6	561.8	6.9	335.3	226.5
8811	44960	11.7	526.0	6.9	310.2	215.8
8812	54006	11.9	641.6	7.0	378.0	263.6
8901	14747	12.1	178.4	7.6	112.1	66.4
8902	6410	13.0	83.5	8.6	55.1	28.3
8903	6769	13.3	89.8	8.4	56.9	32.9
8904	30349	14.1	428.5	9.4	285.3	143.2
8905	55498	13.7	760.3	7.3	405.1	355.2

Table A5-12a: Monthly point source loadings of phosphorus to Rice Lake from the Harwood fish hatchery.

Monthly Summary — Harwood Fish hatchery.

	Raceway			Effluent Pond		
Month	Discharge (m3)	Total Phosphorus (mg/L)	Total Phosphorus (kg)	Discharge (m3)	Total Phosphorus (mg/L)	Total Phosphorus (kg)
8606	220860	0.11	24.3	8100	0.44	3.5
8607	228222	0.02	5.2	8370	0.44	3.6
8608	228222	0.07	15.3	8370	0.55	4.6
8609	220860	0.06	12.4	8100	0.49	3.9
8610	228222	0.04	8.7	8370	0.43	3.6
8611	228222	0.03	7.8	8370	0.30	2.5
8612	228222	0.03	6.4	8370	0.32	2.6
8701	228222	0.03	7.1	8370	0.52	4.3
8702	206136	0.06	12.0	7560	0.29	2.2
8703	228222	0.05	11.9	8370	0.45	3.8
8704	220860	0.01	2.2	8100	0.67	5.4
8705	228222	0.05	11.0	8370	0.55	4.6
8706	220860	0.11	24.3	8100	0.44	3.5
8707	228222	0.02	5.2	8370	0.44	3.6
8708	228222	0.07	15.3	8370	0.55	4.6
8709	220860	0.06	12.4	8100	0.49	3.9
8710	228222	0.04	8.7	8370	0.43	3.6
8711	228222	0.03	7.8	8370	0.30	2.5
8712	228222	0.03	6.4	8370	0.32	2.6
8801	228222	0.03	7.1	8370	0.52	4.3
8802	213498	0.06	12.4	7830	0.29	2.3
8803	228222	0.05	11.9	8370	0.45	3.8
8804	220860	0.01	2.2	8100	0.67	5.4
8805	228222	0.05	11.0	8370	0.55	4.6
8806	220860	0.11	24.3	8100	0.44	3.5
8807	228222	0.02	5.2	8370	0.44	3.6
8808	228222	0.07	15.3	8370	0.55	4.6
8809	220860	0.06	12.4	8100	0.49	3.9
8810	228222	0.04	8.7	8370	0.43	3.6
8811	228222	0.03	7.8	8370	0.30	2.5
8812	228222	0.03	6.4	8370	0.32	2.6
8901	228222	0.03	7.1	8370	0.52	4.3
8902	206136	0.06	12.0	7560	0.29	2.2
8903	228222	0.05	11.9	8370	0.45	3.8
8904	220860	0.01	2.2	8100	0.67	5.4
8905	228222	0.05	11.0	8370	0.55	4.6

Table A5-12b: Monthly point source loadings of phosphorus to Rice Lake from the Harwood fish hatchery.

Monthly Summary		Harwood Fish hatchery			
Month	Raceway + Effluent (kg)	Discharge (m3)	Background Total Phosphorus (mg/L)	Background Total Phosphorus (kg)	Final Load (kg)
8606	27.8	228960	0.005	1.14	26.7
8607	8.9	236592	0.005	1.18	7.7
8608	19.9	236592	0.002	0.47	19.4
8609	16.3	228960	0.002	0.46	15.8
8610	12.3	236592	0.007	1.66	10.6
8611	10.3	236592	0.005	1.18	9.1
8612	9.0	236592	0.008	1.89	7.1
8701	11.4	236592	0.011	2.60	8.8
8702	14.1	213696	0.010	2.14	12.0
8703	15.7	236592	0.009	2.13	13.5
8704	7.6	228960	0.007	1.60	6.0
8705	15.6	236592	0.006	1.42	14.2
8706	27.8	228960	0.005	1.14	26.7
8707	8.9	236592	0.005	1.18	7.7
8708	19.9	236592	0.002	0.47	19.4
8709	16.3	228960	0.002	0.46	15.8
8710	12.3	236592	0.007	1.66	10.6
8711	10.3	236592	0.005	1.18	9.1
8712	9.0	236592	0.008	1.89	7.1
8801	11.4	236592	0.011	2.60	8.8
8802	14.6	221328	0.010	2.21	12.4
8803	15.7	236592	0.009	2.13	13.5
8804	7.6	228960	0.007	1.60	6.0
8805	15.6	236592	0.006	1.42	14.2
8806	27.8	228960	0.005	1.14	26.7
8807	8.9	236592	0.005	1.18	7.7
8808	19.9	236592	0.002	0.47	19.4
8809	16.3	228960	0.002	0.46	15.8
8810	12.3	236592	0.007	1.66	10.6
8811	10.3	236592	0.005	1.18	9.1
8812	9.0	236592	0.008	1.89	7.1
8901	11.4	236592	0.011	2.60	8.8
8902	14.1	213696	0.010	2.14	12.0
8903	15.7	236592	0.009	2.13	13.5
8904	7.6	228960	0.007	1.60	6.0
8905	15.6	236592	0.006	1.42	14.2

APPENDIX 4

APPENDIX 5

APPENDIX 6

ATTACHMENT 2

<u>RICE-STURGEON SHORELINE DEVELOPMENT STUDY</u>

TASK 6 OF THE STURGEON-RICE NUTRIENT BUDGET STUDY

NOVEMBER 1987

MINISTRY OF THE ENVIRONMENT, CENTRAL REGION

ENVIRONMENTAL QUALITY ASSESSMENT UNIT

ENVIRONMENTAL RESPONSE GROUP

RICE-STURGEON SHORELINE DEVELOPMENT STUDY

TASK 6 OF THE STURGEON-RICE NUTRIENT BUDGET STUDY

INTRODUCTION

The purpose of the Shoreline Development Study was to estimate the nutrient inputs from lakeshore development. This task involved the compilation and verification of township and municipal assessment records to determine the amount and type of development around each lake. Nutrient inputs were determined using the verified development data and anthropogenic total phosphorus input values established by the Shoreline Development Study resort questionnaire and the Lakeshore Capacity Study Trophic Status Component (L.C.S., 1986).

METHOD

Assessment maps and assessment roll data for the townships were obtained by visiting Peterborough and Northumberland assessment offices. Municipal assessment information for Sturgeon Point and Bobcaygeon was obtained from their respective municipal offices. The assessment roll lists, by roll number, each lot and its corresponding land use

assessment code. The roll for a particular year lists land use assessed the previous year. Assessment maps are not updated annually and dates of amendments varied from 1982 to 1987. The potential for discrepancy between the assessment roll and maps and the existing shoreline development necessitated field verification.

Field verification was undertaken by matching a building on the shore to an assessment roll number and (previously recorded) code on the map. Distinctive land uses were used as starting points. They also provided checks between the maps and existing development. Each lot was recorded with its roll number, assessment code, township name, map number and date. Visible housing units, resorts, and commercial buildings were given a reference number. Approximately every twentieth building was photographed and described in detail. This will allow future development to be compared to that of 1987 by counting the number of buildings between those described in detail. Lots serviced by Bobcaygeon Municipal sewers were omitted as they will be included in the point source loading value for the Bobcaygeon Sewage Treatment System.

Permanent and seasonal residences were distinguished by land use assessment codes. From this information values established by L.C.S., Land Use Component (1986) for seasonal, extended summer or year round use were determined

and nutrient inputs to the lakes calculated, (see Appendix). A standard value could not be used for resort usage due to the variabiliy between resorts in terms of number of units, capacity, and occupancy rates. For this reason, resort owners were asked to complete a questionnarire to establish the number of resort units, total resort capacity, and a monthly occupancy rate. This occupancy rate was converted into capita yr/yr/unit. In this way, a unique usage value was established for each resort based on the information provided by the Shoreline Development Study resort questionnaires. Health units were contacted to obtain information regarding type of septic system at each resort. Nutrient loading values for resorts depended upon the phoshorous retention (Rs) ability of the septic system. Assumptions regarding the Rs values for various systems are listed in the Appendix.

Several assumptions were made regarding discrepancies between asssessment codes and existing development. Occasionally the number of lots and number of units between two matched points was not equal. In this case the buildings were grouped logically on the existing lots (ie on the basis of similar structure, paint, landscaping, etc.). 'Extra' buildings were given the same roll number and assessment code as the buildings with which they were grouped. Land assessed as vacant with new buildings or buildings under construction was recorded as having seasonal residential units (RDU). This

assumption was based on the fact that since the majority of the lakeshore around both lakes is assessed as RDU it would be highly probable that these new buildings would also be RDU's. Land which was not assessed, or inaccurately assessed was recorded as having the existing land use.

RESULTS

The total anthropogenic phosphorus loading from the shoreline development of Rice and Sturgeon Lake was calculated for a case one and a case two scenario. These two scenarios differed in that the *retention coefficient (Rs) values were constants for case one and varied for case two, depending on the type of sewage system servicing the unit. This difference in Rs values provided a projected maximum phosphorus loading value for case one and a minimum phosphorus loading value for case two.

All land use groups with the exception of resorts (seasonal dwellings, permanent dwelllings, vacant land (PD), and commercial land), were assigned usage values (capita yr/yr/unit), loading values (kg/capita yr/yr) and retention coefficient (Rs) values which remained constant for both case one and case two scenarios. The scope of the information obtained, with respect to resorts, allowed each resort's phosphorus loading to be calculated using Rs and *usage values that were based on it's sewage system and occupancy rates respectively. Resorts were the only land use group for which the retention coefficient changed between case one and case two, as they were the only group for which sewage system information was obtained. Therefore the extent to which the two scenarios differed in total phosphorus loading values depended on the percentage of the total phosphorus loading which can be attributed to resorts.

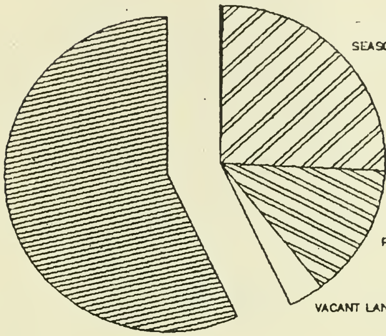
The total anthropogenic phosphorus loading from shoreline development for both Sturgeon and Rice lake, for each of the case scenarios, is given in figure 1 below.

Figure 1: Rice and Sturgeon Lake Total Anthropogenic Phosphorus Loading, Case One and Case Two Scenarios.

	CASE ONE	CASE TWO
RICE LAKE (with vacant land developed)	2850.26 kg/yr.	2504.00 kg/yr.
RICE LAKE (with vacant land not developed)	2751.26 kg/yr.	2405.00 kg/yr.
STURGEON LAKE (with vacant land developed)	2031.04 kg/yr.	1964.09 kg/yr.
STURGEON LAKE (with vacant land not developed)	1918.24 kg/yr.	1851.29 kg/yr.

RICE LAKE ANTHROPOGENIC "P" LOADING

CASE ONE / VACANT LAND DEVELOPED



RICE LAKE ANTHROPOGENIC PHOSPHORUS LOADING: Case one (Rs=0), vacant land (PD) developed

UNIT TYPE	NUMBER OF UNITS	PHOSPHORUS LOADING kg/yr
SEASONAL DWELLINGS (RDU)	1120 ✓	732.0 kg/yr
PERMANENT DWELLINGS (RU)	191 ✓	389.64 kg/yr
VACANT LAND (PD) (VL)	165 ✓	99.0 kg/yr
COMMERCIAL LAND (COMM)	7 ✓	7.11 kg/yr
RESORTS	54 ✓	1622.50 kg/yr

2850.25

Rice Lake

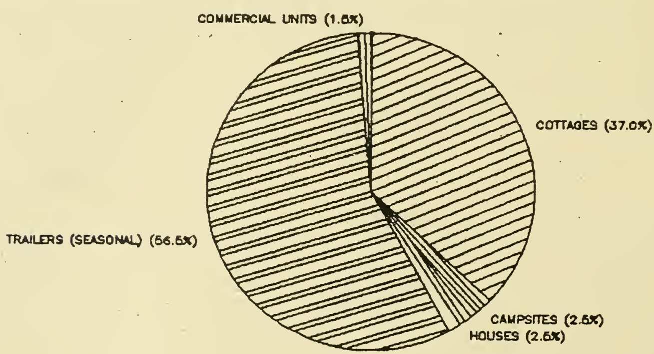
Resorts were the predominate source of anthropogentic phosphorus loading, contributing over fifty percent of the total loading value for Rice lake. With fifty-three resorts on Rice lake the significance of the effectivness of the sewage systems to reduce loading to the lake becomes apparent when considering case one and case two scenarios. Trailer sites consitute over fifty percent of the total phosphorus loading from resorts and as such are the largest supplier of phosphorus to Rice Lake.

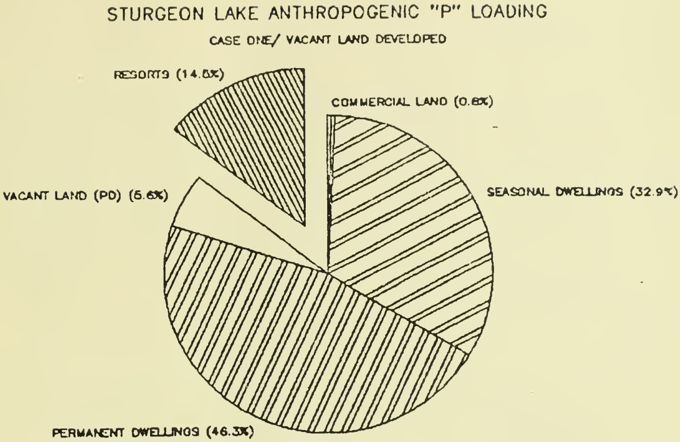
Rice Lake Resort Phosphorus Loading by Unit Type.

TYPE GROUP	CASE ONE	CASE TWO
COTTAGES	599.60 kg/yr	431.86 kg/yr
TRAILERS	917.40 kg/yr	768.50 kg/yr
CAMPSITES	40.32 kg/yr	25.39 kg/yr
HOUSES	40.80 kg/yr	30.03 kg/yr
COMMERCIAL	24.38 kg/yr	20.97 kg/yr
RESORT TOTAL	1622.50 kg/yr	1276.75 kg/yr

RICE LAKE RESORT "P" LOADING

GROUPED BY UNIT TYPE





STURGEON LAKE ANTHROPOGENIC PHOSPHORUS LOADING: Case one (Rs=0), vacant land (PD) developed.

UNIT TYPE	NUMBER OF UNITS	PHOSPHORUS LOADING kg/yr
SEASONAL DWELLINGS (RDU)	1115	669.00 kg/yr
PERMANENT DWELLINGS (RU)	461	940.44 kg/yr
VACANT LAND (PD) (VL)	188	112.80 kg/yr
COMMERCIAL LAND (COMM)	15	15.24 kg/yr
RESORTS	17	293.56 kg/yr

Sturgeon Lake

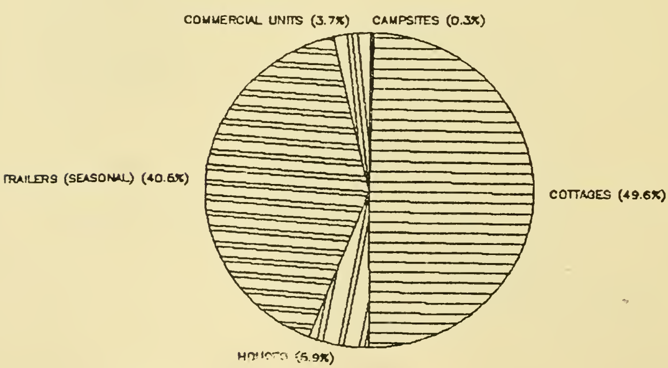
Permanent Dwellings (RU and FRU) constituted approximately fifty percent of the total anthropogenic phosphorus loading value for Sturgeon Lake. Sturgeon Lake has several towns situated on, or near its shoreline and the predominance of permanent dwelling as apposed to seasonal or resort units is mostly likely a result of their presence. The difference in loading values between case one and case two scenarios does not differ to as great an extent for Sturgeon Lake as it does for Rice Lake because resorts contribute less towards total Phosphorus loading (15%) on Sturgeon Lake. Cottages and trailers contributed almost equally towards the total resort phosphorus loading value.

Sturgeon Lake Resort Phosphorus Loading by Unit Type.

TYPE GROUP	CASE ONE	CASE TWO
COTTAGES	145.65 kg/yr	102.72 kg/yr
TRAILERS	118.80 kg/yr	102.38 kg/yr
CAMPSITES	0.96 kg/yr	0.50 kg/yr
HOUSES	17.33 kg/yr	12.48 kg/yr
COMMERCIAL	10.77 kg/yr	8.53 kg/yr
RESORT TOTAL	293.56 kg/yr	226.61 kg/yr

STURGEON LAKE RESORT "P" LOADING

GROUPED BY UNIT TYPE



APPENDIX

RICE-STURGEON SHORELINE DEVELOPMENT STUDY

USAGE AND PHOSPHOROUS LOADING VALUES (L.C.S. 1986)
(EXCLUDING RESORT UNITS)

LAND USE	USAGE (cap yr/yr/unit)	P INPUT (kg/cap/yr)
RDU Trailers OT with buildings VCI with buildings, unless included with a resort	.75 (seasonal)	.80
RU FRU	2.55 (year round)	.80
VL (PD) Vacant land with potential for development OT without buildings	.75 (seasonal)	.80
COM PGA	1.27 (extnd. summer)	.80
VL (ND) Vacant land with no potential for development ie: parks government docks areas for common use access points CA OE LG FL	Included in Phosphorous export values for the lakes	
Campsites	.40	.48

LAND USE ASSESSMENT CODES

RDU	Seasonal dwelling units
RU	Permanent residential units.
FRU	Farm lands on which a farm residence exists.
FL	Farm lands without a farm residence.
CA	Property vested in a Conservation Authority.
VL	Vacant land other than farm land, mining land, or those of a Conservation Authority. Includes all vacant land regardless of ownership.
COM	Commercial property used for business.
VCI	A commercial/industrial unit situated on commercial/industrial land but which is not in use.
FG	Property other than vacant land or residential occupied by the Federal Government.
PGA	Property other than vacant land and residential units occupied by an agency of the Provincial Government.
LG	Property other than vacant land and residential units occupied by municipal, regional or county levels of government.
OE	Certain specified charities and cemeteries that are not associated with a religious organization.
OT	Taxable properties for which a specific unit class code has not been developed.

ASSUMPTIONS MADE REGARDING Rs VALUES FOR RESORT NUTRIENT INPUT CALCULATIONS

Resort with holding tank(s) in good working order, assume total retention, Rs=1.

Resort with holding tank(s) with some leaking, occasional overflow, assume partial retention, Rs=.48.

Resort with holding tank(s) but leaching pit(s) for grey water from laundry and shower facilities, assume Rs=.48.

Resort with septic tank/field systems in good working order, with sand fill in trenches, assume good retention, Rs= .74.

Resort with septic tank/field systems in unknown condition given two scenarios: Case 1 assume no retention, Rs=0.
Case 2 assume some retention, Rs=.48.

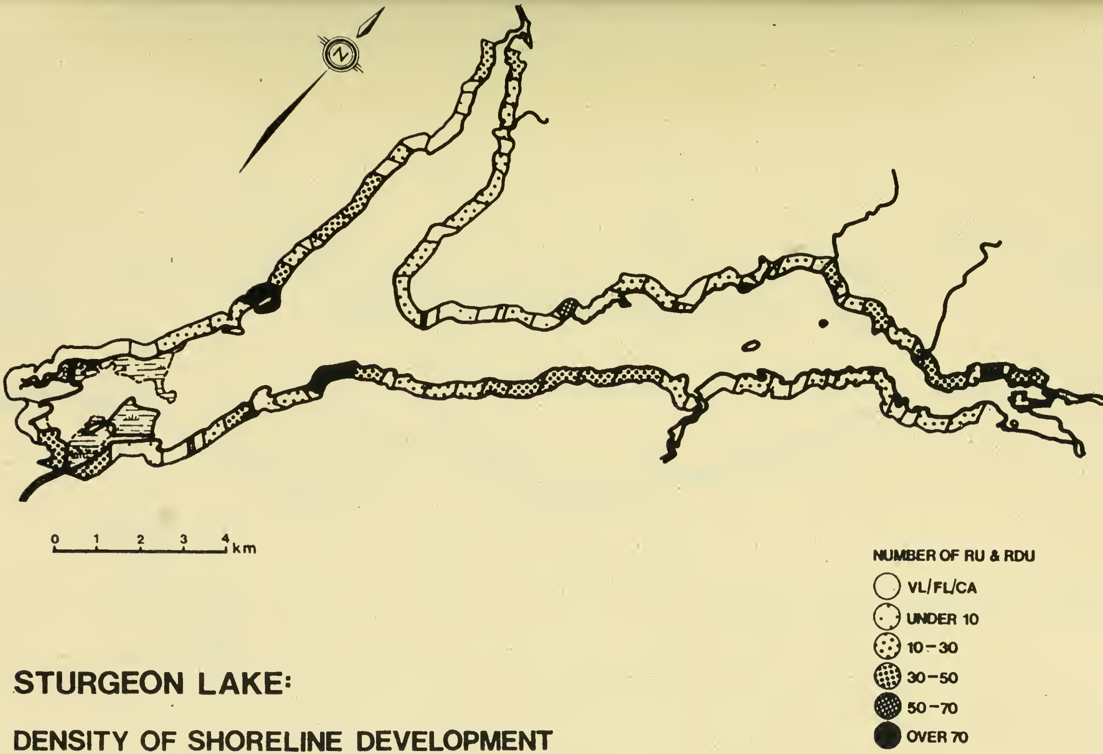
Resort with septic tank/field systems in poor condition assume no retention, Rs=0.

Resort with leaching pits, perforated 45-gallon-drum 'sewers' assume no retention, Rs=0.

Resort with unknown septic system assume no retention, Rs=0.

Resort with combination septic systems, assume appropriate Rs value for each system.

RICE LAKE : DENSITY OF SHORELINE DEVELOPMENT



STURGEON LAKE:

DENSITY OF SHORELINE DEVELOPMENT

ATTACHMENT 3

RESORT NAME: Lucky Fisherman's Lodge

IN Anyold TOWNSHIP.

FRONTAGE ON RICE LAKE ✓ STURGEON LAKE ___ (please check)

NUMBER OF UNITS: 0 ROOMS
5 COTTAGES/CABINS (+ 1 house)
3 TRAILERS
0 CAMPSITES

MONTHS OPEN FOR BUSINESS: May TO October

TOTAL CAPACITY: 20 (total number of people resort will accomodate if full)

AVERAGE # OF UNITS OCCUPIED MONTHLY DURING 1986

MONTH	COTTAGES/CABINS/ROOMS	TRAILERS	CAMPSITES
JANUARY			
FEBRUARY			
MARCH			
APRIL			
MAY	35%		
JUNE	70%		
JULY	100%		
AUGUST	100%		
SEPTEMBER	50%		
OCTOBER	25%		
NOVEMBER			
DECEMBER			

RESORT NAME: Lucky Fisherman's Lodge
TOWNSHIP: Anyold

$\frac{\text{total capacity}}{\text{\# of units}}$ ie 20/5 = 4

$\frac{\text{\# units occupied}}{\text{month}} \times \frac{\text{\# people (capita)}}{\text{unit}}$ ie 1.75 x 4.0 = 7.0 cap/month

$\frac{\text{\# units}}{\text{\% occupancy}}$ ie 5 x 35/100 = 1.75

	# UNITS OCC/MONTH	CAPITA/UNIT	CAPITA/MONTH
JANUARY			
FEBRUARY			
MARCH			
APRIL			
MAY	1.75	4.0 ✓	7.0
JUNE	3.50	4.0	14.0
JULY	5.00	4.0	20.0
AUGUST	5.00	4.0	20.0
SEPTEMBER	2.50	4.0	10.0
OCTOBER	1.25	4.0	5.0
NOVEMBER			
DECEMBER			
		TOTAL	76.0

[illegible] 5 [illegible] = 1.27 [illegible]

TOTAL 'P' LOADING FOR LUCKY FISHERMAN'S LODGE

from information obtained at the Cleanville Health Unit we know: 1 holding tank services the house, ∴ Rs=1.
Septic tank system of unknown condition services the cottages, ∴ Case 1, Rs=0.
∴ Case 2, Rs=.48.
Unknown system services the trailers, ∴ Rs=0.

Phosphorous
Loading = #Units X Usage X P Loading Value X (1-Rs value)

P Loading by House
=1 x 2.55 x .8 x (1-1)
=0 kg/yr

P Loading by Cottages
Case 1, Rs=0
=5 x 1.27 x .8 x (1-0)
=5.08 kg/yr

P Loading by Cottages
Case 2, Rs=.48
5 x 1.27 x .8 x (1-.48)
=2.64 kg/yr

P Loading by Trailers
=3 x .75 x .8 x (1-0)
=1.8 kg/yr

Total Loading for Lucky Fisherman's Lodge = House Loading + Cottage Loading + Trailer Loading

Case 1
=0 + 5.08 + 1.80
=<u>6.88 kg/yr</u>

Case 2
=0 + 2.64 + 1.80
=<u>4.44 kg/yr</u>